

REFERENCE ONLY

*Journal*



REPORT  
 OF THE  
 DEPARTMENT OF MINES  
 FOR THE YEAR  
 WESTERN · 1933. AUSTRALIA

*Journal*



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



H.D. CHILDS

1934.

—  
WESTERN AUSTRALIA.

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# REPORT

OF THE

## DEPARTMENT OF MINES

FOR THE YEAR

1933.

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1934.

# ANNUAL REPORT OF THE DEPARTMENT OF MINES, WESTERN AUSTRALIA, 1933.

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## STATE OF WESTERN AUSTRALIA.

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# Report of the Department of Mines for the State of Western Australia for the Year 1933.

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*To the Hon. the Minister for Mines.*

Sir,

I have the honour to submit the Annual Report of the Department for the year 1933, together with reports from the officers controlling the various sub-departments, and comparative tables furnishing statistics relative to the Mining Industry of the State.

I have, etc.,

M. J. CALANCHINI,  
Under Secretary for Mines.

Department of Mines,  
Perth, 29th March, 1934.

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### DIVISION I.

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*The Hon. the Minister for Mines.*

I have the honour to submit for your information a report on the Mining Industry for the year 1933.

The value of the mineral output of the State for the year was £3,059,957, an increase of £169,689 over the year 1932.

The production of Lead, Gypsum, Pottery Clay, and Tantalite ores declined, but increases were recorded in Arsenic, Asbestos, Coal, Copper, Felspar, Glauconite, Gold, Silver, and Tin.

The normal value of the Gold yield was £2,706,683, being 88.46 per cent. of the total output value.

The value of the Coal output was £289,806; Arsenic, £36,753; Silver, £6,792; Asbestos, £4,917; Tantalite, £2,170; Tin, £4,557; Gypsum, £3,686; Glauconite, £1,745; Felspar, £1,618, and Copper, £1,132.

Dividends paid by mining companies amounted to £534,681, in comparison with £217,968 in the preceding year. In addition, £31,250 were paid in bonuses by one company, which also returned capital to the extent of the same amount. (See Table 6.)

To the end of the year 1933 the total dividends paid by mining companies amounted to £29,632,311. To the same date the total value of the mineral production was £183,768,349, of which the gold production accounts for £170,156,848 based on normal

values; but premiums from sales of gold during 1920-1924 and 1930-1933 and payments under "The Gold Bounty Act, 1930," increased by £7,682,318, the totals of the mineral and gold productions respectively.

#### GOLD.

The gold yield shows an increase, being 31,646 fine ounces greater than in 1932, which was 94,989 fine ounces greater than in 1931.

The average value per ton of ore treated in the State as a whole fell from 38.37 shillings in 1932 to 34.05 shillings in 1933; in the East Coolgardie Goldfield, which produced approximately 56.50 per cent. of the State's reported yield, it fell from 44.07 shillings per ton to 37.23 shillings per ton. The average values for the Wiluna and Mt. Malcolm districts were 23.41 and 30.87 shillings per ton respectively, but the average increased price of gold during the year of over 80 per cent. would materially add to these values.

The tonnage of ore treated in 1933, 1,588,979 tons, showed an increase of 261,958 tons over the year 1932.

Increased tonnages were produced from East Coolgardie (116,053); Yilgarn (11,410); Murchison (13,300); East Murchison (105,738); Dundas (4,062); Phillips River (2,988); Coolgardie (2,673):

Broad Arrow (2,066); Mount Margaret (2,195); North Coolgardie (1,471), and smaller increases from all the other fields, with the exception of Yalgoo, which showed a decline of 1,646 tons.

There were increased outputs of gold from all the fields, excepting East Coolgardie and Yalgoo, which declined by 5,911 and 250 ounces respectively.

The acreage held under mining lease for all minerals is 58,263 acres, being an increase of 4,144 acres when compared with 1932.

The area held for gold mining is greater by 4,534 acres, and for other minerals lesser by 390 acres.

The area held under prospecting areas is 44,093 acres, including 2,753 acres for coal.

This is an increase of 11,162 acres on the area held in 1932, but the area held for coal decreased by 1,642 acres.

The number of men engaged in all classes of mining was 10,690, an increase of 1,995 on the number employed in 1932.

The number of men engaged in mining for minerals other than gold showed an increase of 78.

There was a slight falling off in tantalite and lead mining, but increases in all others.

In gold mining there was an increase of 2,333.

The average value of gold produced per man employed on gold mines was £328.43 in 1932, and £262.48 in 1933, calculated at normal value.

The average tonnage raised per man was 164.37 tons, and in the previous year 172.85 tons, a decrease of 8.48 tons.

The examinations of miners under the provisions of "The Mine Workers' Relief Act, 1932," which superseded "The Miners' Phthisis Act, 1922," were continued during the year.

In the East Murchison field there was an increase of 18,320 fine ounces.

In the Black Range district there was a small decrease in output, despite an increase in the tonnage treated.

At Barrambie a few prospectors were at work.

At Birrigrin the number of men decreased, and the treatment plant was removed.

At Bellechambers only a small number of prospectors were at work, and the only production of any extent was from the Georgina mine. At Curran's Find a small party was engaged prospecting and treating sands on the old Red, White, and Blue mine.

At Hancock's there was an increase in the number of prospectors, and, although a small production was reported, nothing of note was discovered.

At Jonesville there was increased activity.

The "Swan Bitter" and "North End" mines were consistent producers, and appear to be of much promise.

At Maninga Marley there was also an increase in the prospectors at work, but very little production.

At Montague and Nungarra small outputs were recorded.

At Sandstone the number of men employed increased, but no new discoveries were reported.

The "Lady Mary," "Bonny Note," and "Dalmatian" each reported a good output.

At Youanmi the number at work was small.

The only production was a small one from the old Youanmi mine. Towards the end of the year

an option over this mine was taken by a London company, and preparations made to carry out a programme of diamond drilling early in the new year. If the results are encouraging the mine will be re-opened.

In the Lawlers district mining has shown increased activity, but returns have not been up to expectations. Outputs were reported from Kathleen Valley, Marshall's Pool, and Mt. Sir Samuel, in addition to Lawlers itself, and the production was slightly in excess of the previous year.

In the Wiluna district there was an increased yield, mainly due to the enhanced production of the Wiluna Gold Mines, Limited. In the outlying centres there was considerable activity, and returns were reported from Cole's Find, Corboy's Find, Diorite, Kingston, Mt. Eureka, Mt. Keith, New England, and Waldcek's Find. The outlook for Wiluna is most promising.

The Murchison field had an increase of 646 fine ounces.

In the Meekatharra district there was an increased output.

The principal contributor was, as hitherto, Meekatharra itself, but crushings were also reported from Abbott's, Bourke's Find, Burnakura, Garden Gully, Gabamtha, Gum Creek, Holden's Find, Jilawarra, Meekatharra Hills, Mt. Maitland, Nannine, Quinn's, Ruby Well, State Well, Yalginga, and Wanganui. Throughout the district prospecting was very active.

In the Cue district there was a small increase, and the State battery at Cue was fully employed throughout the year. Outputs were reported from Cue, Behring Pool, Cuddingwarra, and Mindoolah.

At Cuddingwarra boring was still being done on the Big Bell leases.

At Reedy's active work is in progress on the Triton mine, and the future of this property is regarded to be most promising. Throughout the district there has been increased activity in mining.

In the Day Dawn district there was a decrease. The district is being well prospected and a good number of men are working, but no new developments of note were noted.

In the Mt. Magnet district there was a small increase.

In the immediate vicinity of Mt. Magnet there has been a very marked revival. The Hill 60 mine, which has been a consistent producer, was acquired by an English company, which has been carrying out an extensive programme of exploration and development. It is understood that the results are most promising, and the erection at an early date of a treatment plant is probable.

The alluvial deep lead at Boogardie was largely abandoned, only a few crushings from alluvial claims being reported. Crushings were reported from Lennonville, where several prospectors were at work; also Paynesville, but the Moyagee centre was almost deserted and no production was recorded.

The Peak Hill goldfield had an increase of 903 fine ounces.

In the immediate vicinity of Peak Hill there was a marked increase in activity, and most of the old mines were again working.

Crushings were reported from Jimble Bar, Mt. Seabrook, Murphy's Well, and a small one from Wilthorpe.

At Horseshoe nothing was done on the manganese deposits, but a few prospectors were at work.

The Yalgoo field had a decrease of 250 fine ounces.

In the immediate vicinity of Yalgoo mining was somewhat quiet, but in most of the outlying centres many prospectors were operating.

At Goodingnow there was increased activity, and a number of good crushings were reported. Outputs were also recorded from Bilberatha, Carlaminda, Field's Find, Gullewa, Messenger's Patch, Mt. Gibson, Noongal, Retaliation, Rothsay, Warda Warra, and Warriedar.

The Mt. Margaret field had an increase of 3,932 fine ounces.

In the Mt. Margaret district the principal producing centres were Burtville, Hawk's Nest, Mt. Varden, Ida H, and Eristoun. The old Lancefield mine was re-opened in August, after being closed down for many years. A strong company has been formed to develop it, and it is predicted that its future is promising. A good many men are already employed. Throughout the district prospecting was active. The reported find from the Livesey Ranges, referred to in last year's report, was not confirmed on investigation.

In the Mt. Morgans district there was considerable activity at Morgans, and the development work done on the "Renown" group of leases is very promising. A good deal of activity has also been in evidence on the Westralia Mt. Morgans mine, where a plant for retreatment of a large dump has been erected. A new find was reported from a locality about 16 miles south of Linden and several prospecting areas were taken up, but it is too early yet to form an opinion as to its permanence.

At Murrin some good crushings were obtained, and at Linden the "Bindah" mine, which had been shut down for some years, again entered the list of producers. The prospects of the district generally are brighter than they have been for years.

In the Mt. Malcolm district there was a small increase. As hitherto, the chief production was from the Sons of Gwalia mine, which continues its policy of active development and production. Crushings were also reported from several small shows in the neighbourhood of Leonora. In the outlying centres a large number of prospectors were working, and returns were reported from Cardinia, King of the Hills, Lake Darlot, Malcolm, Mertondale, Mt. Clifford, Randwick, Waite Kauri, and Webster's Find. Generally speaking, mining throughout the district was very brisk. The Coolgardie field had an increase of 1,546 fine ounces. A great deal of prospecting was going on in the immediate vicinity of Coolgardie, where also the Western Mining Corporation was testing by diamond drill the "Big Blow" and other properties.

The State mill was kept going at high pressure. At Tindals nothing of note transpired.

From Gibraltar some crushings were reported, and a good deal of prospecting was in evidence.

Crushings were also reported from Burbanks and Bonnievale.

At Widgiemoortha a local syndicate has erected a 10-head mill, and anticipate being kept fully occupied by the many prospectors now in the locality.

At Larkinvile a few alluvial workers are still searching.

At Jourdie Hills the old "Wealth of Nations" mine was again taken up, and a programme of development work is being carried out. At Higginsville a company operating the "Two Boys" mine has erected a 5-head mill, and the prospects of the property are encouraging.

From St. Ives some crushings were reported, and prospecting was active.

In the Kunanalling district the "Star of Fremantle" and "Melva Maie" mines have been re-opened, and development is proceeding. A good deal of work is in progress in this district, and outputs were reported from Carbine, 25-Mile, and Chadwin.

The North Coolgardie field had an increase of 4,213 fine ounces.

In the Menzies district there has been marked activity in the neighbourhood of Menzies, and several good crushings have been reported. A privately-owned treatment plant has been kept fully occupied.

At Yuandaga only a small amount of work was going on.

At Comet Vale the Sand Queen-Gladsome mine was still under exemption, but is expected to be actively developed shortly.

At Mt. Ida the Timoni syndicate is actively developing the property, and the outlook is encouraging. In the Ularring district some very rich ore was unearthed on the old Lady Gladys mine at Mulline, and sensational yields obtained. If the reef lives down it will be a big producer; elsewhere nothing of note transpired.

In the Yerilla district there was a good deal of activity at Yarri, and some promising finds were reported, including one of gold in porphyry which is unique, and the development of which will be watched with interest.

At Edjudina much prospecting was going on.

At Yarri the State mill treated an increased tonnage.

In the Niagara district there was not any marked change. Returns were reported from Jessop's Well, Kookynie, Niagara, and Tampa, but no new finds were recorded.

The North-East Coolgardie field had an increase of 194 fine ounces.

Mining throughout this field was quiet, and no new finds were reported. Outputs were reported from Kanowna, Kalpini, Gordon, Jubilee, and Mulgabbie.

In the Kurnalpi district there was a small output, but generally matters were quiet.

The Broad Arrow field had an increase of 2,443 fine ounces. This field was again the scene of great activity by prospectors. The State mill at Ora Banda was busily occupied, and put through an increased tonnage. So promising is the field that the Government put in hand an extension of the Goldfields Water Scheme to Ora Banda.

At Ora Banda itself much work is in progress, and at Grant's Patch several properties are being worked and tested by companies, and a good deal of success has been recorded. Returns were reported from Broad Arrow, Ora Banda, Siberia, Black Flag, Paddington, Fenbark, Grass Patch, also Bardoc, where the Bardoc Consolidated Company is actively developing its property, and a large number of prospectors is also at work.

The outlook for this field is excellent.

In the East Coolgardie goldfield the number of men engaged in mining was 3,275, and in 1932, 2,911, an increase of 364. This goldfield gave employment to over 33 per cent. of the number of men engaged in gold mining, and the reported production for the year was 359,708 fine ounces, over 56 per cent. of the total reported yield. The tonnage treated was 820,861 tons, being 116,054 tons greater than 1932. The yield showed a decrease of 5,912 fine ounces on the preceding year. The average grade of the ore per ton fell from 44.07 in 1932 to 37.23 shillings in 1933. The "Lake View and Star" mine maintained its position as the premier producer, and on this mine a large amount of development work was done and a big increase in ore reserves made.

At all the other large mines steady progress was maintained. The "Great Boulder" proposes to erect a new treatment plant in the coming year. At the north end of the field the Broken Hill Proprietary Company completed the erection of a treatment plant on the Hannans North. Throughout the field several old mines are being re-opened and exploratory work undertaken, and a large amount of diamond drilling is in evidence. The State mill has been kept going continuously, and will probably have to be enlarged shortly.

At Hampton Plains, Binduli, Golden Ridge, Mt. Monger, and Boorara many prospectors were at work.

From the Bulong district crushings were reported, but no new developments transpired.

The Yilgarn field had an increase of 7,578 fine ounces.

At Bullfinch there was considerable activity, and a large number of crushings was reported.

At Corinthia and Ennuin prospecting was active, and good returns were obtained.

In the Golden Valley centre there was a substantial production, and the "Radio" and "Radio Deeps" were again consistent producers. Outputs were also reported from Holleton, Hope's Hill, Kennyville, Marvel Loch, Mt. Jackson, Parker's Range, Southern Cross, and Westonia. At the latter centre the principal activity was by the Princess Royal Company. Throughout this goldfield prospecting was most active, and the outlook is exceedingly promising.

The Dundas field had an increase of 1,737 fine ounces. On the Norseman gold mine a vigorous policy of development was carried out, and an additional treatment plant was in course of erection. At the Phoenix mine a great deal of development work was also done, and indications are promising. Several prospecting shows have also been producing ore, and the State battery has been kept fully occupied.

The Phillips River field had an increase of 772 fine ounces. Mining in this field was very active.

The Hatter's Hill centre was responsible for a good proportion of the output.

At Kundip the Beryl Gold Mines, Limited, were carrying out diamond drilling operations, and had some very encouraging results. Batteries were in operation at Hatter's Hill, Kundip, and Ravensthorpe, and accounted for much of the increased activity. The outlook is decidedly promising.

The Pilbara field had an increase of 968 fine ounces. A fair number of prospectors were working throughout this field. In the vicinity of Marble Bar a strong English company has acquired the "Apex"

mine, and it is proposed to actively develop it forthwith.

At Nullagine attention is being given to the "conglomerates," and it is hoped to interest English investors in developing them. Crushings were reported from Marble Bar, Bamboo Creek, Lalla Rookh, and a couple of other centres, and increased tonnages were treated at the State mills at Marble Bar and Bamboo Creek.

There was not any production from the West Kimberley goldfield and no mining work was being done.

The Ashburton goldfield recorded an increase of 24 fine ounces, the Gascoyne goldfield an increase of 26 fine ounces, and the Kimberley goldfield an increase of 118 fine ounces. In the two former, mining was almost entirely restricted to fossicking for alluvial. In Kimberley there was some activity in the neighbourhood of Mt. Dockerell, where several prospectors were at work. From districts outside the proclaimed goldfields productions were reported from West Pilbara, where the lack of crushing facilities has been a retarding factor. However, towards the close of the year two companies took preliminary steps to engage in operations there, and, if developments are encouraging, intend to establish crushing facilities. This would result in increased activity throughout the field. Also from Burracoppin, where an average of eight men has been employed, and Toodyay, where an average number of 15 prospectors was operating at Jumperdine. It is stated a crushing plant will shortly be erected at this centre.

#### TIN.

The quantity of tin exported was 37 tons, valued at £4,557, a decrease in tonnage of two tons, but increase in value of £1,262. The production reported was 12.50 tons, valued at £1,494, from the Pilbara field, and three tons, valued at £413, from the Greenbushes field. In the latter field there was not any improvement.

#### TANTALITE.

Eight tons, valued at 2,170, were exported; a decrease in tonnage of two tons, and in value of £514. This was all produced in the Pilbara field.

#### COPPER.

Thirty-five (35) tons of copper, valued at £1,132, were exported, but there was not any reported production.

#### LEAD.

One (1) ton of lead, valued at £13, was exported, and a similar amount was reported as produced in the State generally, *i.e.*, outside any proclaimed field.

Mining in the Northampton field was practically at a standstill, and no ore was produced.

#### COAL.

The output of coal was 458,399 tons, being 42,680 tons greater than in 1932. The whole output was from Collie, the deposits at Wilga remaining unworked.

The number of men employed, 626, was greater by 22 men than in 1932, and the output per man was, in 1932, 688 tons, and in 1933, 732 tons. There was not any change of note in the Collie field during the year.

## OIL.

The Freney Kimberley Company continued boring operations, but without any success. Towards the end of the year an oil geologist arrived from England, to inspect and report on the areas held by the company. The Wooramel holdings were also prospected by the licensees, who are now contemplating further intensive operations.

On the South-West coastal areas prospecting was continued, and a certain amount of shallow boring done without any success.

## ASBESTOS.

The reported production was 266 tons, valued at £4,917; an increase in tonnage of 156 tons, and in value of £3,155.

In the West Pilbara district 259 tons, valued at £4,687, were raised, and in the Pilbara goldfield seven tons, valued at £230.

## OTHER MINERALS.

The quantity of silver obtained as a by-product and exported was 67,036 ounces, valued at £6,792; an increase in ounces of 8,751 and in value of £1,188.

Lead and silver lead amounted to five tons, valued at £55; a decrease in tonnage of three tons and in value of £57. Also 1,331 tons of arsenic, valued at £36,753, and 453 tons of felspar, valued at £1,618.

The production was reported of 349 tons of glauconite, valued at £1,745, and 2,608 tons of gypsum, valued at £3,686.

## MINING GENERALLY.

The Western Australian gold production was 63.59 per cent. of the total for Australasia, and in the preceding year 68.09 per cent.

There was not any marked improvement in mining for base metals, as the low prices ruling for most of them militated against any increase in activity.

In gold mining there was a wonderful advance, the great improvement noted in the previous year being more than maintained. The principal factors responsible for this are, of course, the enhanced price of gold and the high rate of exchange. For the last four (4) years there has been a steady rise

in the figures of output. It is confidently anticipated that increase in production will continue for some years. Recently a considerable amount of capital has been coming to the State for investment in the industry, and extensive prospecting operations by way of aerial and geophysical surveys are being carried out.

The policy of assisting prospectors with loans of equipment, etc., was superseded in May by the inauguration of a scheme on a more generous basis. Under this some 3,000 applications were received and considered; 2,146 applicants were approved and sent into the field.

At the end of the year there were 1,700 men at work, and the majority of them had raised gold-bearing ore. The cost of this scheme to the end of the year was £30,465 9s. 4d., while refunds of sustenance payments totalled £1,245. The scheme was then in full swing, and a considerable amount of prospectors' ore was awaiting treatment.

Several parties have been most successful, having struck rich veins, which yielded sufficient to relieve them of financial troubles for a long time. The men assisted were all destitute, and undoubtedly the scheme has done a lot of good, not only from a mining point of view, but in relieving unemployment and also in restoring the men's morale and giving them an opportunity which exists in practically no other industry of obtaining by their labours sudden wealth.

Including applications dealt with prior to the commencement of the new scheme 862 new parties, comprising 2,186 men, and extensions to 23 existing parties, comprising 60 men, were approved, a total of 885 parties, comprising 2,246 men. The expenditure thereon totalled £30,709 3s. 2d. At the close of the year 660 parties, totalling 1,700 men, were operating.

The area held under prospecting areas for gold and minerals, apart from coal, viz., 41,340 acres, is greater by 12,804 acres than in the preceding year, indicative of the great amount of prospecting now going on.

The expenditure incurred in rendering assistance to mine owners and the industry generally under the provisions of the Mining Development Act totalled £50,807 6s. 4d., and in the preceding year £24,089 10s. 8d.



## PART II.—MINERALS RAISED.

TABLE 1.

*Quantity and Value of Minerals produced during Years 1932 and 1933.*

Description of Minerals.	1932.		1933.		Increase or Decrease for Year compared with 1932.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		£		£		£
1. Arsenic (exported), statute tons ... ..	1,477	26,161	1,331	36,753	— 146	+ 10,592
2. Asbestos (reported), statute tons ... ..	110	1,762	266	4,917	+ 156	+ 3,155
3. Coal (raised), statute tons ... ..	415,719	270,630	453,399	289,306	+ 42,680	+ 19,176
4. Copper (exported), statute tons ... ..	...	...	35	1,132	+ 35	+ 1,132
5. Felspar (exported), statute tons ... ..	361	1,399	453	1,618	+ 92	+ 219
6. Glauconite (reported), statute tons ... ..	186	930	349	1,745	+ 163	+ 815
7. Gold (exported and minted), fine ozs. ... ..	605,561	*2,572,260	637,207	*2,706,683	+ 31,646	+ 134,423
8. Gypsum (reported), statute tons ... ..	3,647	5,354	2,608	3,686	— 1,039	— 1,668
9. Lead (in Concentrates) (reported), statute tons ... ..	...	...	1	13	+ 1	+ 13
10. Lead and Silver Lead Ore (exported), statute tons ... ..	8	112	5	55	— 3	— 57
11. Pottery Clay (raised), statute tons ... ..	76	47	...	...	— 76	— 47
12. Silver (exported), fine ozs. ... ..	58,285	5,604	67,036	6,792	+ 8,751	+ 1,188
13. Tantalite (exported), statute tons ... ..	10	2,684	8	2,170	— 2	— 514
14. Tin (exported), statute tons ... ..	39	3,295	37	4,557	— 2	+ 1,262
...	...	£2,890,238	...	£3,059,927	...	+ £169,689

\* The value of fine gold is computed at £4 4s. 11·45d. per ounce, in addition £1,831,383 and £2,179,571 were received by Producers for years 1932 and 1933 respectively.

TABLE 2.

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

Year.	Total Exports.	Mineral Exports (exclusive of Coal).	Percentage.
	£	£	
1902 ... ..	9,051,358	7,530,319	83·20
1903 ... ..	10,324,732	8,727,060	84·53
1904 ... ..	10,271,489	8,625,676	83·98
1905 ... ..	9,871,019	7,731,954	78·33
1906 ... ..	9,832,679	7,570,305	76·99
1907 ... ..	9,904,860	7,544,992	76·17
1908 ... ..	9,518,020	7,151,317	75·13
1909 ... ..	8,860,494	5,906,673	66·66
1910 ... ..	8,299,781	4,795,654	57·78
1911 ... ..	10,606,863	7,171,638	67·61
1912 ... ..	8,941,008	5,462,499	61·09
1913 ... ..	9,128,607	4,608,188	50·48
1914 ... ..	8,406,182	3,970,182	47·23
1915 ... ..	6,291,934	2,969,502	47·19
1916 ... ..	10,878,153	6,842,621	62·92
1917 ... ..	9,323,229	5,022,694	53·87
1918 ... ..	6,931,834	2,102,923	30·34
1919 ... ..	14,279,240	6,236,585	43·67
1920 ... ..	15,149,323	3,096,849	20·44
1921 ... ..	10,331,405	1,373,810	13·30
1922 ... ..	11,848,025	2,875,402	24·27
1923 ... ..	11,999,500	3,259,476	27·16
1924 ... ..	13,808,910	1,424,319	13·24
1925 ... ..	13,642,852	173,126	1·27
1926 ... ..	14,668,184	1,597,698	10·89
1927 ... ..	15,805,120	472,041	2·99
1928 ... ..	16,911,932	996,099	5·88
1929 ... ..	16,660,742	1,802,709	10·82
1930 ... ..	19,016,639	6,370,396	33·49
1931 ... ..	14,266,650	4,333,421	30·37
1932 ... ..	16,771,465	5,657,870	33·74
1933 ... ..	18,098,214	5,328,869	29·44
Total since 1902 ...	379,700,443	148,732,867	39·18

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.					
	1932.	1933.	Percentage for each Goldfield		Average Value of Gold per ton of Ore treated.	
			1932.	1933.	1932.	1933.
	fine ozs.	fine ozs.			shillings.	shillings.
1. Kimberley ... ..	64	182	.011	.029	...	...
2. Pilbara ... ..	3,940	4,908	.657	.771	105.62	98.03
3. Ashburton ... ..	11	35	.002	.005	191.88	...
4. Gascoyne ... ..	...	26	...	.004	...	111.37
5. Peak Hill ... ..	2,191	3,094	.365	.486	27.97	37.00
6. East Murchison... ..	105,742	124,062	17.641	19.478	26.07	23.41
7. Murchison ... ..	27,460	28,106	4.581	4.413	36.04	30.59
8. Yalgoo ... ..	5,426	5,176	.905	.813	43.28	48.83
9. Mt. Margaret ... ..	45,686	49,618	7.622	7.790	28.89	30.87
10. North Coolgardie ... ..	6,384	10,597	1.065	1.664	89.02	119.01
11. Broad Arrow ... ..	8,281	10,724	1.382	1.684	74.01	78.73
12. North-East Coolgardie ... ..	894	1,088	.149	.171	69.68	68.54
13. East Coolgardie ... ..	365,620	359,708	60.996	56.475	44.07	37.23
14. Coolgardie ... ..	9,271	10,817	1.547	1.698	59.77	57.97
15. Yilgarn ... ..	14,778	22,356	2.465	3.510	56.53	56.49
16. Dundas ... ..	2,501	4,238	.417	.665	47.34	42.10
17. Phillips River ... ..	617	1,389	.103	.218	48.94	29.06
State generally ... ..	555	804	.092	.126	109.71	249.43
Totals and averages ... ..	599,421	636,928	100.000	100.000	38.37	34.05

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, Perth, which 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 1932 and 1933.

Goldfield.	1932.				1933.			
	Tons of Gold Ore raised and treated.		Fine ounces of Gold produced therefrom.		Tons of Gold Ore raised and treated.		Fine ounces of Gold produced therefrom.	
	Per man employed under ground.	Per man employed above and under ground.	Per man employed under ground.	Per man employed above and under ground.	Per man employed under ground.	Per man employed above and under ground.	Per man employed under ground.	Per man employed above and under ground.
	tons.	tons.	fine ozs.	fine ozs.	tons.	tons.	fine ozs.	fine ozs.
1. Kimberley ... ..	...	...	...	...	...	...	...	...
2. Pilbara ... ..	60.94	30.18	66.04	32.70	43.85	27.98	50.60	32.29
3. Ashburton ... ..	...	...	...	...	...	...	...	...
4. Gascoyne ... ..	...	...	...	...	20.00	10.00	26.22	13.11
5. Peak Hill ... ..	229.42	102.35	73.07	32.60	222.02	92.26	96.69	40.18
6. East Murchison ... ..	543.50	296.03	166.48	90.68	596.44	326.55	164.32	89.97
7. Murchison ... ..	193.24	82.57	79.69	34.05	143.71	66.98	51.76	24.13
8. Yalgoo ... ..	53.52	27.10	27.02	13.68	44.80	22.34	25.75	12.84
9. Mt. Margaret ... ..	350.81	218.47	118.88	74.03	315.37	176.66	114.59	64.19
10. North Coolgardie ... ..	40.08	18.74	41.04	19.20	32.19	14.19	45.09	19.88
11. Broad Arrow ... ..	69.38	30.96	54.38	24.27	53.08	23.24	49.19	21.53
12. North-East Coolgardie ... ..	30.28	13.13	19.08	8.28	25.78	9.79	20.92	7.94
13. East Coolgardie ... ..	439.40	245.75	227.27	127.11	430.45	250.64	188.62	109.83
14. Coolgardie ... ..	60.73	26.89	37.16	16.46	50.00	19.99	34.12	13.64
15. Yilgarn ... ..	151.08	67.50	100.23	44.78	139.50	71.38	92.76	47.46
16. Dundas ... ..	121.33	49.88	67.03	27.55	131.55	58.97	65.20	29.23
17. Phillips River ... ..	26.78	18.46	13.80	9.52	126.84	67.65	43.40	23.14
Total Averages ... ..	331.40	172.85	148.25	77.32	309.86	164.37	124.21	65.89

TABLE 5.

*Output of Gold from the several States of Australasia, the Northern Territory, Papua, and the Dominion of New Zealand during 1933.*

	Output of Gold.	Value.*	Percentage of Total.	
			Output of Commonwealth.	Output of Australasia.
	Fine ozs.	£		
1. Western Australia ... ..	637,207	2,706,683	75·829	63·588
2. Victoria ... ..	58,183	247,145	6·924	5·806
3. New South Wales ... ..	29,252	124,254	3·481	2·919
4. Queensland ... ..	91,997	390,779	10·948	9·181
5. Papua ... ..	9,991	42,439	1·189	·997
6. Tasmania ... ..	6,672	28,341	·794	·666
7. South Australia ... ..	6,361	27,020	·757	·635
8. Northern Territory ... ..	659	2,799	·078	·066
9. New Zealand ... ..	161,755	687,092	...	16·142
	1,002,077	4,256,522	100·000	100·000

\* Exclusive of Premium.

TABLE 6.

*Dividends, etc., paid by Western Australian Mining Companies during 1933 and Total to date.*

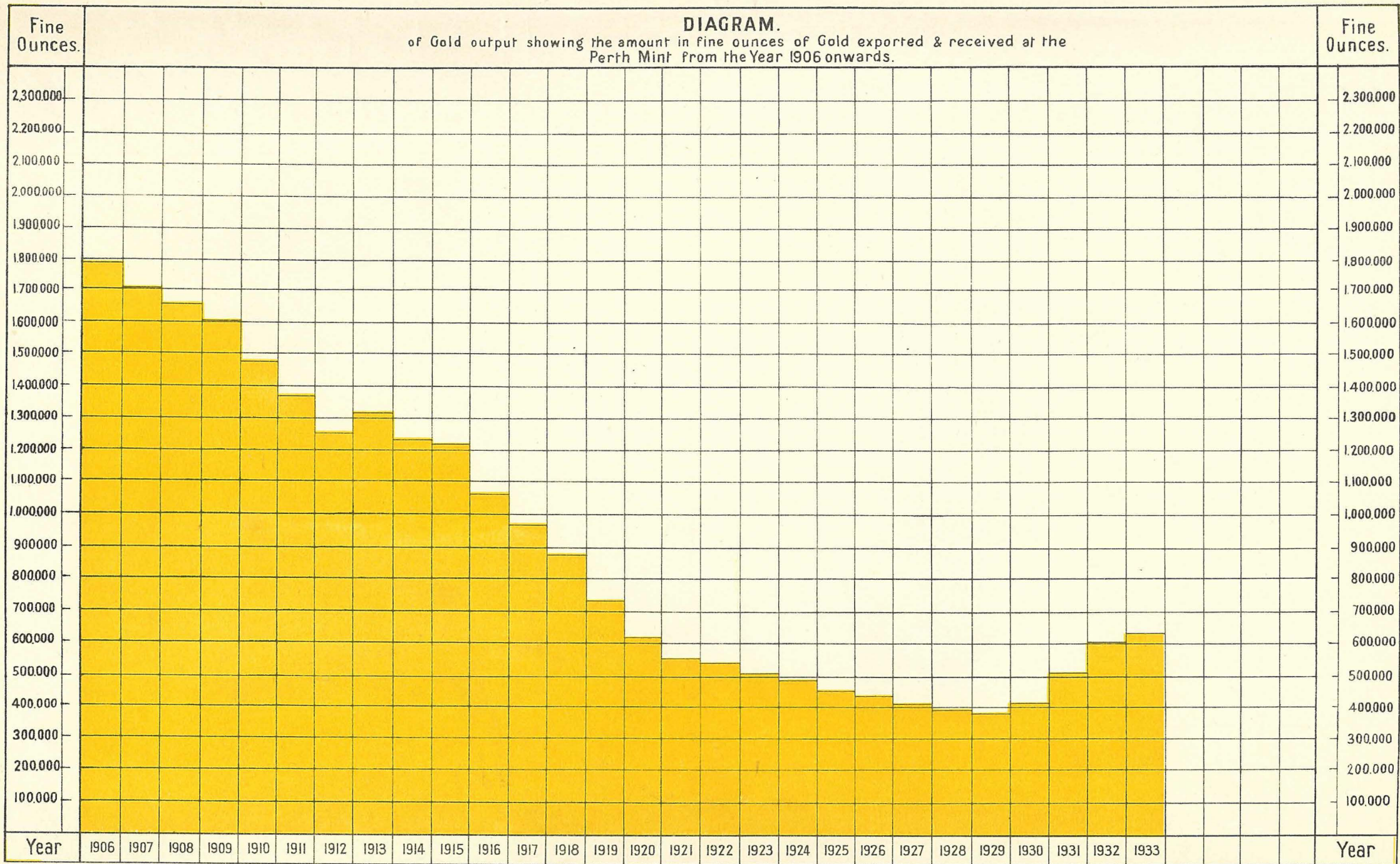
(Compiled from information supplied by the Government Statistician's Office.)

Goldfield.	Name of Company.	Bonus.	Capital returned.	Dividends.	
				1933.	Grand total paid to end 1933.
		£	£	£	£
Peak Hill ... ..	Various Companies ... ..	...	...	...	160,666
East Murchison ... ..	do. do. ... ..	...	...	...	437,968
Murchison ... ..	do. do. ... ..	...	...	...	1,992,670
Mt. Margaret ... ..	Sons of Gwalia, Ltd. ... ..	...	...	48,750	1,193,488
Do. ... ..	Various Companies ... ..	...	...	...	376,213
North Coolgardie ... ..	do. do. ... ..	...	...	...	575,032
North-East Coolgardie ... ..	do. do. ... ..	...	...	...	89,854
East Coolgardie ... ..	Associated G.Ms. of W.A. (New), Ltd. ... ..	...	...	29,768	44,652
Do. ... ..	Boulder Perseverance, Limited ... ..	...	...	37,438	1,603,294
Do. ... ..	Golden Horseshoe (New), Ltd. ... ..	...	(c)	27,500	27,500
Do. ... ..	Great Boulder Proprietary G.Ms., Ltd. ... ..	...	...	65,625	6,217,217
Do. ... ..	Lake View and Star, Limited ... ..	...	...	270,000	335,000
Do. ... ..	North Kalgurli (1912), Limited ... ..	...	...	18,750	18,750
Do. ... ..	South Kalgurli Consolidated, Ltd. ... ..	(a) 31,250	(b) 31,250	31,250	596,251
Do. ... ..	Other Companies ... ..	...	...	...	14,882,837
Coolgardie ... ..	Various Companies ... ..	...	...	...	339,495
Yilgarn ... ..	Princess Royal G.M. Co., No. Liability ... ..	...	...	5,600	5,600
Do. ... ..	Other Companies ... ..	...	...	...	513,199
Dundas ... ..	Various Companies ... ..	...	...	...	222,625
		31,250	31,250	534,681	£29,632,311

(a) In addition to £31,250 in 1932.

(b) In addition to £62,500 in 1932.

(c) £55,000 returned in 1932.



Note:— Previous to 1906, Gold Produced, 14,871,687 Fine Ozs.  
Peak Year 1903, Gold Produced, 2,064,801 " "

TABLE 7.

Quantity and Value of Minerals, other than Gold, reported to the Mines Department during 1933.

Goldfield, District, or Mineral Field.	1933.		Increase or Decrease for Year as compared with 1932.			
	Quantity.	Value.	Quantity.	Value.		
	tons.	£	tons.	£		
BLACK TIN.						
Pilbara Goldfield (Marble Bar District) ... ..	12·50	1,494	+	5·50	+	810
Greenbushes Mineral Field ... ..	3·00	413	—	5·25	—	312
Total ... ..	15·50	1,907	+	·25	+	498
ASBESTOS.						
Pilbara Goldfield (Marble Bar District) ... ..	7·00	230	+	7·00	+	230
State generally (West Pilbara) ... ..	259·00	4,687	+	149·05	+	2,925
Total ... ..	266·00	4,917	+	156·05	+	3,155
GYPSUM.						
Yilgarn Goldfield (Yellowdine) ... ..	602·00	602	+	236	+	236
State generally (Baandee) ... ..	503·00	754	—	1,442	—	2,163
(Woolundra) ... ..	1,503·00	2,330	+	167	+	259
Total ... ..	2,608·00	3,686	—	1,039	—	1,668
FELSPAR.						
Coolgardie G.F. (Coolgardie) ... ..	453	1,618	+	92	+	219
	453	1,618	+	92	+	219
GLAUCONITE.						
State generally (Moora District) ... ..	349	1,745	+	163	+	815
	349	1,745	+	163	+	815
TANTALITE.						
Pilbara Goldfield (Marble Bar District) ... ..	8	2,170	—	2	—	514
	8	2,170	—	2	—	514
LEAD.						
State Generally ... ..	1	13	+	1	+	13
	1	13	+	1	+	13

The low prices offering for ores and concentrates containing base metals, and for the metals themselves, prevailed throughout the year 1933. The number of men reported as being engaged in the winning of minerals other than gold showed a substantial increase, but is accounted for by a mild revival in tin mining at Greenbushes, more men being employed at Collie, as reflected in the increase in the output of coal as shown in Table 8, and the inclusion of men employed on the arsenic plant at Wiluna, not being

previously reported separately. There were increases in the quantities of asbestos reported, as the local product met with a larger demand, not only in Perth, but also in the Eastern States. The quantity of tantalite entered for export, and the amount of gypsum raised, both declined, the latter mainly on account of some of the deposits becoming worked out. The value of felspar, glauconite, silver, and tin all showed increases.

TABLE 8.

Quantity of Coal raised during 1932 and 1933, estimated Value thereof, Number of Men employed, and Output per Man.

Coalfield.	Year	Quantity raised.	Estimated Value.	Men employed.		Quantity raised.	
				Above ground.	Under-ground.	Per Man employed under-ground.	Per Man employed above and under-ground.
		tons.	£			tons.	tons.
Collie ... ..	1932	415,719	270,630	120	484	859	688
	1933	458,399	289,806	119	507	904	732

There was an improvement all round in the 1933 figures, when compared with 1932 results. The output showed an increase of 42,680 tons of an estimated value of £19,176; the average number of men employed increased by 22 and the production per man engaged underground and the total number employed increased by 45 and 44 tons respectively.

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

TABLE 9.

Total Number and Acreage of Leases and Prospecting Areas held for Mining on 31st December, 1932 and 1933.

Description of Leases.	1932.		1933.	
	No.	Acreage.	No.	Acreage.
Gold Mining leases on Crown land ... ..	538	8,715	803	13,163
"    "    " private property ... ..	4	82	8	168
Mineral leases on Crown land ... ..	197	45,222	177	44,832
"    "    " private property ... ..	4	100	4	100
Prospecting Areas ... ..	1,694	32,931	2,276	44,093
	2,437	87,050	3,268	102,356

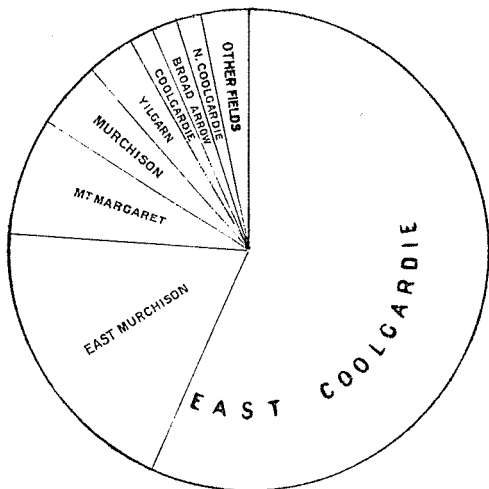
The total number of leases held for mining purposes increased by 249, and the area by 4,144 acres, as compared with the year 1932. The number of leases for gold mining increased by 269 and the area by 4,534 acres. The number of mineral leases decreased by 20 and the area by 390 acres.

For the year 1932 the number of prospecting areas held was 1,694, of a total acreage of 32,931, including 2 areas of 4,395 acres for coal.

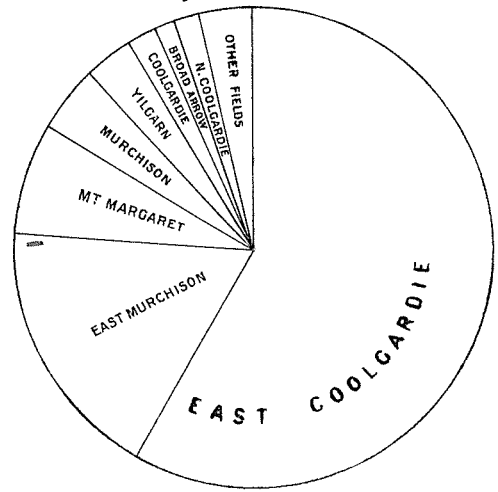
For the year 1933 the number of prospecting areas held was 2,276, of a total acreage of 44,093, including 3 areas of 2,753 acres for coal.

**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 1933.

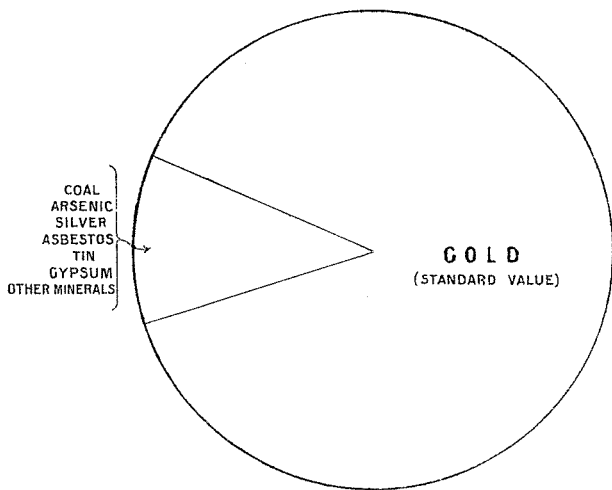
**FIG. 1.** Output of Gold from various Goldfields as reported to Mines Dept.



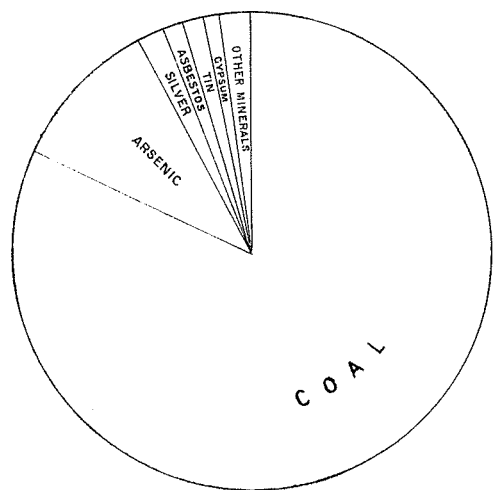
**FIG. 2.** Gold produced from various Goldfields as given by the Export and Mint Returns.



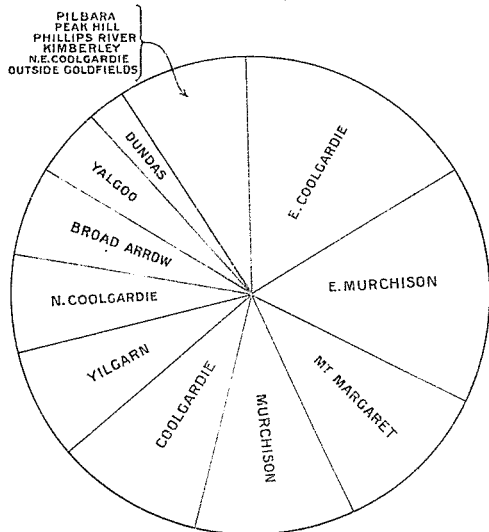
**FIG. 3.** Value of Gold and other Minerals.



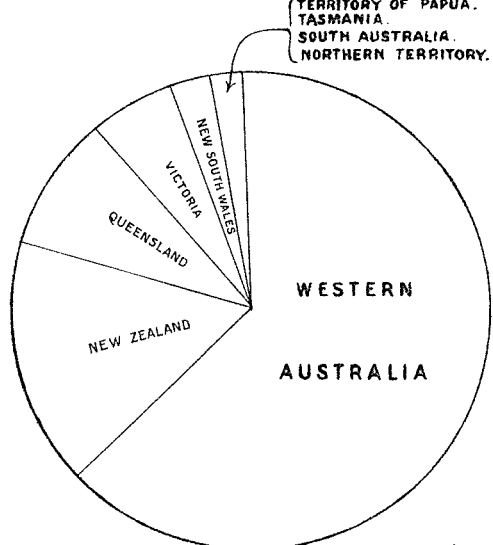
**FIG. 4.** Value of Minerals other than Gold.



**FIG. 5.** Areas of Land leased for Goldmining on various Goldfields.

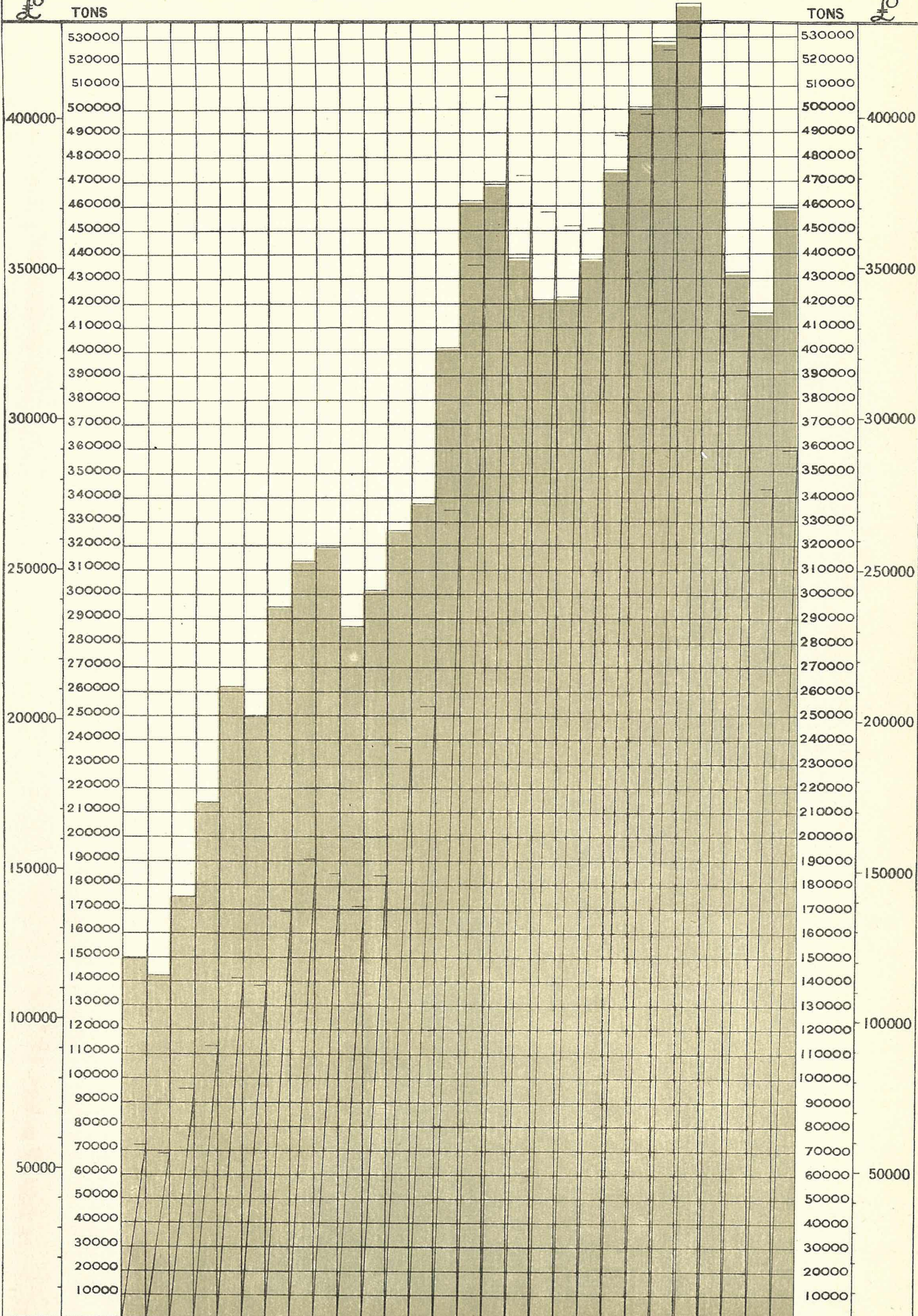


**FIG. 6.** Output of Gold in the States of Australia and the Dominion of New Zealand.



# D I A G R A M

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

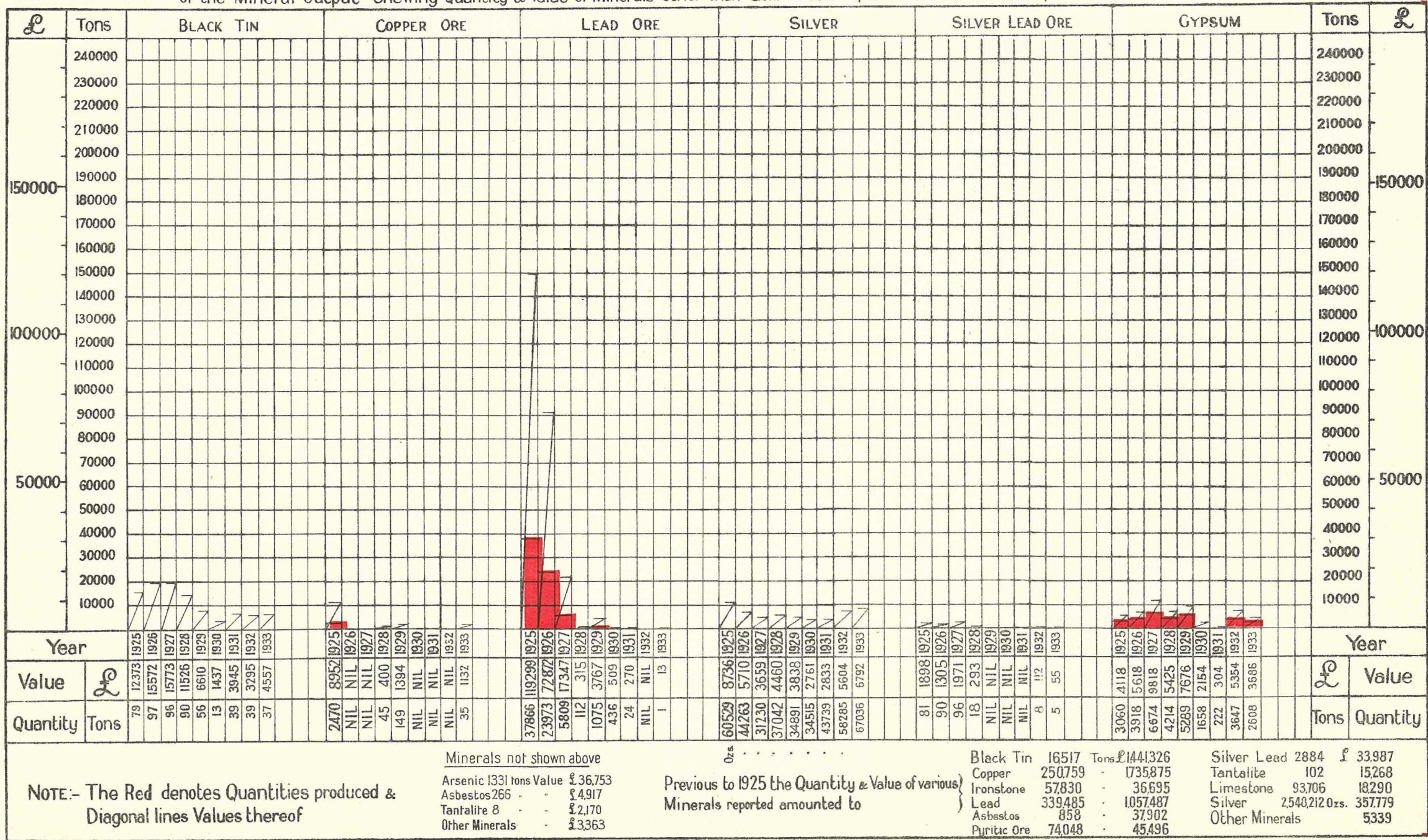


Year		1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	Year	
Value	£	57998	55158	75694	90965	113699	111154	135857	153614	148684	137589	147823	191822	204319	270355	350346	407117	381555	368949	363255	363203	394400	407967	420145	426706	394758	336178	270630	289806	Value	£
Quantity	Tons	149765	142373	175248	214302	262166	249890	295079	313818	319210	286666	301526	326550	337039	401713	462021	468817	438443	420714	421864	437461	474819	501505	528420	544719	501425	432400	415719	458399	Quantity	Tons



# D I A G R A M

of the Mineral Output - shewing Quantity & Value of Minerals other than Gold & Coal reported to the Mines Dep<sup>t</sup> from the Year 1925 onwards



## PART IV.—MEN EMPLOYED.

TABLE 10.

*Average number of Men engaged in Mining during 1932 and 1933.*

Goldfield.	District.	Reef or Lode.		Alluvial.		Total.	
		1932.	1933.	1932.	1933.	1932.	1933.
1. Kimberley ... ..	...	...	...	4	3	4	3
2. Pilbara ... ..	Marble Bar ... ..	94	140	8	1	102	141
	Nullagine ... ..	11	7	2	4	13	11
3. Ashburton ... ..	...	2	...	2	2	4	2
4. Gascoyne ... ..	...	...	2	2	...	2	2
5. Peak Hill ... ..	...	65	77	...	...	65	77
6. East Murchison ... ..	Lawlers ... ..	64	82	6	...	70	82
	Wiluna ... ..	905	1,063	...	...	905	1,063
	Black Range ... ..	195	234	1	...	196	234
	Cue ... ..	178	327	...	...	178	327
7. Murchison ... ..	Meekatharra ... ..	272	364	...	...	272	364
	Day Dawn ... ..	83	135	...	...	83	135
	Mt. Magnet ... ..	251	339	...	...	251	339
8. Yalgoo ... ..	...	393	403	...	...	393	403
9. Mt. Margaret ... ..	Mt. Morgans ... ..	94	148	...	...	94	148
	Mt. Malcolm ... ..	419	461	9	15	428	476
	Mt. Margaret ... ..	102	149	...	...	102	149
	Menzies ... ..	120	181	3	6	123	187
10. North Coolgardie ... ..	Ularring ... ..	56	106	...	2	56	108
	Niagara ... ..	51	65	6	8	57	73
	Yerilla ... ..	98	160	2	5	100	165
11. Broad Arrow ... ..	...	307	482	11	16	318	498
12. North-East Coolgardie ... ..	Kanowna ... ..	57	91	4	9	61	100
	Kurnalpi ... ..	26	33	3	4	29	37
13. East Coolgardie ... ..	East Coolgardie ... ..	2,811	3,151	40	44	2,851	3,195
	Bulong ... ..	57	77	3	3	60	80
14. Coolgardie ... ..	Coolgardie ... ..	415	600	124	63	539	663
	Kunanalling ... ..	75	122	6	8	81	130
15. Yilgarn ... ..	...	329	468	1	3	330	471
16. Dundas ... ..	...	90	142	2	3	92	145
17. Phillips River ... ..	...	58	60	...	...	58	60
State generally ... ..	...	66	32	...	...	66	32
Total—Gold Mining ... ..		7,744	9,701	239	199	7,983	9,900
MINERALS OTHER THAN GOLD.							
Asbestos ... ..	Pilbara ... ..	...	2	...	...	...	2
	West Pilbara ... ..	8	7	...	...	8	7
Arsenic ... ..	Wiluna ... ..	...	35	...	...	...	35
Coal ... ..	Collie ... ..	604	626	...	...	604	626
Glauconite ... ..	Moora ... ..	2	3	...	...	2	3
Gypsum ... ..	State generally ... ..	14	20	...	...	14	20
	Yilgarn ... ..	5	7	...	...	5	7
Tantalite ... ..	Pilbara ... ..	20	15	...	...	20	15
Tin ... ..	Greenbushes ... ..	33	55	...	...	33	55
	Pilbara ... ..	...	...	8	8	8	8
Lead ... ..	Northampton ... ..	16	10	...	...	16	10
Felspar ... ..	Coolgardie ... ..	2	2	...	...	2	2
		8,448	10,483	247	207	8,695	10,690

## PART V.—ACCIDENTS.

TABLE No. 11.

MEN EMPLOYED IN MINES, KILLED AND INJURED IN MINING ACCIDENTS DURING  
1932 AND 1933.

## A.—According to Locality of Accident.

Goldfield.	Killed.		Injured.		Total Killed and Injured.	
	1932.	1933.	1932.	1933.	1932.	1933.
1. Kimberley ... ..	...	...	...	...	...	...
2. West Kimberley ... ..	...	...	...	...	...	...
3. Pilbara ... ..	...	...	...	...	...	...
4. West Pilbara ... ..	...	...	...	...	...	...
5. Ashburton ... ..	...	...	...	...	...	...
6. Gascoyne ... ..	...	...	...	...	...	...
7. Peak Hill ... ..	...	...	...	...	...	...
8. East Murchison ... ..	6	2	47	78	53	80
9. Murchison ... ..	1	1	19	24	20	25
10. Yalgoo ... ..	...	...	...	...	...	...
11. Mt. Margaret ... ..	3	...	26	64	29	64
12. North Coolgardie ... ..	...	2	2	...	2	2
13. North-East Coolgardie ... ..	...	...	...	...	...	...
14. Broad Arrow ... ..	1	...	1	...	2	...
15. East Coolgardie ... ..	3	12	158	186	161	198
16. Coolgardie ... ..	...	1	...	1	...	2
17. Yilgarn ... ..	1	1	1	1	2	2
18. Dundas ... ..	1	2	...	2	1	4
19. Phillips River ... ..	...	...	...	...	...	...
MINING DISTRICTS—						
Northampton ... ..	...	...	...	...	...	...
Greenbushes ... ..	...	...	...	...	...	...
Collie ... ..	...	1	124	190	124	191
Swan ... ..	1	...	2	...	3	...
Total ... ..	17	22	380	546	397	568

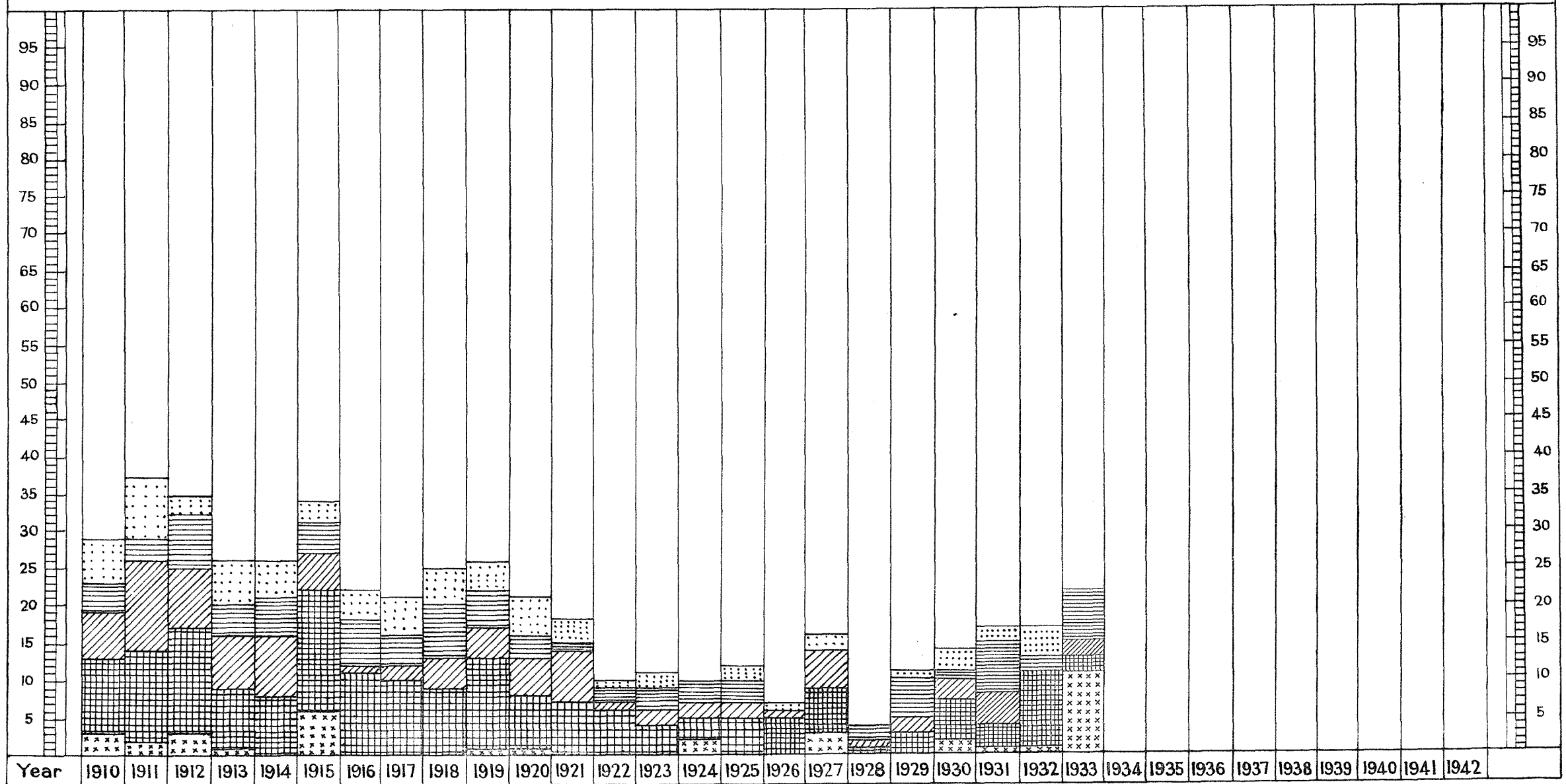
From the above table it will be seen that the total number of fatal accidents for the year 1933 is 22, as against 17 in the preceding year. The number injured shows an increase of 166. In the report of the State Mining Engineer, published as Division II. of this report, these accidents are classified according to the causes.

## B.—According to Causes of Accidents.

	1932.		1933.		Comparison with 1932.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1. Explosives ... ..	1	9	11	12	+ 10	+ 3
2. Falls of Ground ... ..	10	41	2*	51	— 8	+ 10
3. In Shafts ... ..	...	4	2	4	+ 2	...
4. Miscellaneous Underground ... ..	2	248	7	366	+ 5	+ 118
5. Surface ... ..	4	78	...	113	— 4	+ 35
	17	380	22	546	+ 5	+ 166

Twenty-one fatal accidents occurred at gold mines and one in a coal\* mine. The death rate per 1,000 men employed at gold mines was 2.16 as against 2.07 in 1932.

DIAGRAM SHEWING THE NUMBER OF DEATHS FROM ACCIDENTS ARRANGED IN FIVE CLASSES,  
IN THE MINES OF WESTERN AUSTRALIA DURING THE YEARS 1910 AND ONWARDS.



Explosions

Falls of Ground

In Shafts

Miscellaneous Underground

On Surface Including Machinery

## PART VI.—STATE AID TO MINING.

The number of State batteries existing at the end of the year was 25 with four leased.

From inception to end of 1933 gold and tin to the value of £7,119,412.14 have been recovered from State plants; 1,759,488.44 tons of auriferous ore have been treated and have produced £5,665,862.85 by amalgamation; £1,085,097.81 by cyanidation; £265,266.11 by slimes; £9,353.37 worth from residues, and 81,786 tons of tin ore produced tin to the value of £93,834, and in addition £572 were recovered from residues.

During the year the gold ore treated was 91,616.00 tons for 53,012.72 ounces of bullion by amalgamation producing 49,774.25 tons of payable tailings yielding 15,704.85 ounces, and 25,796.75 tons of unpayable tailings yielding 2,084.50 ounces, and making a total of 75,571.00 tons for 17,789.35 ounces.

The working expenditure for all plants for the year was £80,785 6s. 6d., and the revenue £110,160 17s. 1d., which shows a profit of £29,375 10s. 7d. on the year's operation.

The capital expenditure since the inception of the scheme has been £429,306 11s. 7d.; £337,325 7s. 5d. from General Loan Fund and £91,981 4s. 2d. from Consolidated Revenue Fund.

The cost of administration for the year was £4,926 10s. 8d., as against £4,340 8s. 1d. for 1932.

The working expenditure from inception to the end of the year exceeds the revenue by £142,390 13s. 8d.

## GEOLOGICAL SURVEY.

During the year the following mines and deposits were examined, and reports furnished by members of the staff of this Branch.

1. Ingliston Consols Extended and Fenian Gold Mines, Meekatharra.
2. Lady Central Gold Mine, Meekatharra.
3. Ingliston Alberts Gold Mine, Meekatharra.
4. Some Typical Deep Leads at Greenbushes Tinfield.

5. Wannaway Gold Mines.

6. Welsh's Find near Yarri.

7. Glauconite Sands at Gingin.

A new edition of the geological map of the State has been compiled and is now in the printer's hands, also a revised edition of Jutson's Physiography of Western Australia (Bulletin 95) has been edited, and is now in the stage for the page proof to be printed.

## ASSISTANCE UNDER MINING DEVELOPMENT ACT, 1902.

The following statement shows the sum advanced during the year 1933 under "The Mining Development Act 1902":—

	£	s.	d.
Advanced in aid of mining work and equipment of mines with machinery	151	19	2
Subsidies on stone crushed for public	474	11	7
Providing means of transport, equipment, and sustenance to prospectors	30,709	3	2
Amount advanced to Unemployment Relief Department for sustenance to unemployed engaged prospecting	5,905	18	2
	£37,241	12	1

Other assistance granted from the Vote during the year on various matters totalled £13,565 14s. 3d. The subsidies paid on stone crushed for the public amounted to £474 11s. 7d., 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 3,204 $\frac{1}{4}$  tons. The receipts under the Mining Development Act, exclusive of interest payments, amounted to £5,018 14s. 3d., and included refunds of advances, £2,461 17s. 5d.; sales of securities, £1,045 1s. 6d.; miscellaneous refunds, £1,511 15s. 4d.; total, £5,018 14s. 3d.

## PART VII.—INSPECTION OF MACHINERY.

The Chief Inspector of Machinery reports that the number of useful boilers registered at the end of the year totalled 3,784, as against 3,722 total for the preceding year, showing an increase after all adjustments of 62 boilers.

Of the total 3,784 useful boilers 2,152 were out of use at the end of the year; 1,567 thorough and 22 working inspections were made, and 1,577 certificates were issued.

Permanent condemnations totalled 13, and temporary condemnations 22. There were no conversions. Two boilers were transferred beyond the jurisdiction of the Act, and two were reinstated.

The total number of machinery groups registered was 10,076 against 9,550 for previous year, showing an increase of 526.

Inspections made total 7,555, and 3,443 certificates were granted.

Two hundred and seventy-one applications for engine-drivers' and boiler attendants' certificates were received and dealt with, and 225 certificates, all classes, were granted as follows:—

Winding Competency (including certificates issued under Regulation 40 and Section 60) .. .. .	5
First Class Competency (including certificates issued under Regulations 40 and 45, and Sections 60 and 63) .. .. .	11

Second Class Competency (including certificates issued under Regulation 40 and Section 60) .. .. .	25
Third Class Competency (including certificates issued under Regulation 45 and Section 63) .. .. .	27
Locomotive Competency .. .. .	3
Traction Competency .. .. .	1
Internal Combustion Competency .. .. .	27
Crane and Hoist Competency .. .. .	8
Boiler Attendants' Competency .. .. .	112
Interim .. .. .	1
Copies .. .. .	1
Transfers .. .. .	4
	—
	225
	—

The total revenue from all sources during the year was £6,125 8s. 1d. as against £5,656 14s. 7d. for the previous year, showing an increase of £468 13s. 6d.

The total expenditure for the year was £5,177 8s. 8d. as against £4,667 8s. 3d. for the previous year, showing an increase of £510 0s. 5d.

## PART VIII.—SCHOOL OF MINES.

In this the 30th year of the School's existence there was, as in the preceding year, an increase in the number of enrolments. The individual enrolments numbered 306, the highest for a number of years; but, as is usual, there was a considerable falling off towards the end of the year. Class attendances were satisfactory. Students from the School continue to find suitable employment at various mines.

In the metallurgical laboratory there was a considerable increase of work consequent on the re-opening of old mines and activity in the treatment of old residue dumps all over the State.

Excellent work has been done by the staff by way of advice and recommendations as to the methods of treatment which should be most advantageously adopted.

The number of assays and chemical determinations done in connection with the metallurgical investigations was:—Assays for gold, 1,543; chemical determinations, 902.

The continued activity in prospecting is indicated in the number of free assays and mineral determinations for prospectors considerably in excess of those for 1932. The total number was 2,151, and in the preceding year 1,670.

## CONCLUSION.

In dealing with the various activities of the Department I have commented only on the principal items. Detailed information is given in the reports of the responsible officers published as Divisions II. to VIII. of this report.

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.

Department of Mines,

Perth, 29th March, 1934.

## DIVISION II.

### Report of the State Mining Engineer for the Year 1933.

*The Under Secretary for Mines.*

Sir,

In the absence of Mr. A. M. Howe, State Mining Engineer, I have the honour to submit for the information of the Hon. Minister for Mines, my report on the operations of this branch of the Mines Department for the year 1933.

#### STAFF.

With the exception of the appointment, on the 19th January, 1933, of Mr. L. P. J. Gibbons, to the vacant position, caused by the retirement of Mr. E. J. Gourley, District Inspector of Mines, Kalgoorlie, no alteration was made in the Inspectorial staff during the year.

*Workmen's Inspector of Mines.*—In June, Mr. L. C. Darcey was re-elected for a further period of two years to the position of Workmen's Inspector of Mines, Kalgoorlie.

#### ACCIDENTS.

During the year, 22 fatal and 546 serious accidents were reported to this office, showing an increase of 5 fatal and 166 serious accidents. In comparing these figures, however, the increased number of men employed in mining, as shown hereunder, must be taken into consideration, and it must also be borne in mind that the additional men employed have necessarily been for the most part inexperienced. Table II., showing the locality and causes of fatal and serious accidents, is forwarded herewith for inclusion in your Annual Report, together with a diagram of the fatal accidents year by year and their causes. (See Division I., Report of the Under Secretary for Mines.)

The table hereunder gives the number of fatal accidents recorded during the last five years, and the death rate per thousand men:—

—	1929.	1930.	1931.	1932.	1933.
Fatal accidents to men engaged in mining ... ..	11	14	17	17	22*
Total number of men engaged in mining (average) ... ..	5,159	5,442	7,147	8,695	10,690
Accident death rate per 1,000 men ... ..	2.13	2.57	2.38	1.96	2.06

\* One fatal accident occurred at a coal mine. The remainder occurred at gold mines.

#### FATAL ACCIDENTS.

These accidents occurred under the following headings:—Explosives, 11; Falls of Ground, 2; In Shafts, 2; Miscellaneous Underground, 7. These are briefly referred to:—

*Explosives.*—In one instance, an experienced miner was working in a rise and fell from a staging, 15 feet from the ground, as a result of an explosion, due to drilling into a misfired hole. He was seriously injured by the explosion, and died about nine days later.

Another miner was killed by boring into a butt of a missed hole, and the evidence suggested that it was due to the ore in the face not being sufficiently cleaned up.

A machine miner who had been working alone was found dead in the 700ft. level of a mine, as

a result, apparently, of a premature explosion, but, at the inquest, no evidence was given to prove how the accident actually occurred.

A miner lost his life through inhaling fumes from blasting. The air had been turned on in the east face for about 15 minutes, where deceased had commenced working, and when it was turned off, the fumes in the west drive travelled back to the east. The deceased was quickly affected when the other workmen were not. According to the evidence, this was due to a constitutional weakness.

Three men were killed by an explosion when firing out in the end of a drive. The many tests made could not reveal any running fuse. After searching inquiry, no evidence was forthcoming to show definitely the actual cause of this premature explosion.

Another explosive accident, which caused the deaths of two men, was due to an explosion of a missed charge, when it was bored into by a popper drill.

Another case of an alleged premature explosion when lighting up a round of fuses caused injury to a miner. His mate, at great personal risk, showed remarkable bravery in going to his assistance and carrying him to safety before the other shots exploded, but the injured man died from an infection of the wounds a fortnight later. The Local Road Board made a recommendation to the Royal Humane Society for the recognition of this brave action.

For the first time in the history of the Golden Mile, two miners were charged with manslaughter for having killed another worker by neglect of the mining regulations when firing a winze. A shoveller was passing the winze in question when a shot went off. He was found blown to pieces at the bottom of the winze. The accident occurred just before knock-off time, and the accused miners thinking that all the underground workers had already gone to the shaft, did not guard the northern approach to the winze, and as a result, a man was killed. The jury returned a verdict of not guilty.

*Falls of Ground.*—Only two fatalities occurred from falls of rock in underground workings, one of which was due to a fall of coal at Collie. The place was very well timbered, and there was no evidence of negligence.

In the other case, a prospector had fired out a cut at the end of a short drive off a shallow shaft. Next morning he commenced cleaning out the drive when a fall occurred. The ground was soft and greasy, and it appears that he had delayed too long in barring down the back.

*In Shafts.*—Two fatal accidents were recorded under this heading. One man was engaged sinking in a main shaft when about a ton of rock fell from the wall of the shaft 16 feet above him. He and his mate had fired out in the bottom of the new shaft about half an hour previously. The wall had been examined carefully by the underground manager, and there was no evidence of negligence.

The other shaft accident was caused by a pipe fitter, who was doing repair work, slipping and falling down the shaft between the 300 ft. and 400 ft. levels. He was climbing up the corner of the shaft to the 300 ft. plat, and being an elderly man, he was not as capable of climbing in this way as a younger man would be.

*Miscellaneous Underground.*—The seven fatalities included in this group were due to a variety of causes.

An unusual accident occurred to a prospector who was fatally burned when fossicking about old shallow workings. He lit his candle and then dropped the match, which ignited some old powder. Subsequently, a warning was issued through the press for prospectors to exercise care when examining old workings where magazines had previously been in use.

One man was accidentally struck on the head at the 3300ft. level, while riding on an electric train when it was passing an ore chute. This was contrary to instructions, and notices have been posted to prevent any person, other than the driver, riding on the motor.

An old miner who was prospecting some abandoned workings was found dead in a drive. The evidence indicated that deceased slipped when climbing a ladder in a pass and fell about 20 feet. No other person was present at the time of the accident.

A young miner was fatally injured by being caught in ore on a rill. From the evidence it was not certain whether deceased was attempting to "run" the rill or was climbing up the rill.

Another young man was working on a grizzly, and it was his duty to see that the rock came down freely. The rill hung up and he went up the rill to try to dislodge the obstruction by using a 12ft. firing stick, and in doing so, was caught by falling rock.

Two young men went down the ladders of a shaft, approximately 245 feet in depth, the first 65 feet of which were vertical, and the remainder on the underlay, in order to repair the skids, when one man was overcome with dynamite fumes, and his mate just managed to reach the surface to give the alarm. In a gallant attempt to effect a rescue, another workman lost his life, and several members of the rescue party were affected, but recovered after treatment. The men on the previous shift had fired out before midnight. After several men had been affected by the fumes, it was discovered that the air had not been turned on fully, and that the kibble was directly in line with the air-pipe, about three feet from it. Had the air-jet been fully opened and no obstruction in the shaft, the air would have displaced the fumes at the bottom of the shaft.

The fullest inquiry was made into this unfortunate occurrence, and mine managers have had their attention drawn to the danger of inexperienced men being allowed to go below without at least one experienced miner, and to the necessity of dropping the hose pipe to the bottom of the shaft or winze.

In the case of each accident an endeavour was made by the Department to ascertain the cause of the accident, and to see if the Mines Regulation Act had been infringed in any way.

In twenty of the twenty-two fatal accidents, the jury at the inquest brought in a verdict that no blame was attachable to anyone.

In one instance a rider was brought in that, in their opinion, a man firing out should not be working alone, and in the case already referred to, in which two miners were charged with manslaughter, the jury brought in a verdict that the victim lost his life as the result of the neglect of these two miners to comply with the firing regulations.



The following table shows all the fatal and serious accidents reported to this office during 1933, and are classified according to the gold or mineral field in which they occurred. The causes of accidents are also shown:—

	Explosives.		Falls of Ground.		In Shafts.		Miscellaneous Under-ground.		Surface.		Total.	
	Fatal.	Seri-ous.	Fatal.	Seri-ous.	Fatal.	Seri-ous.	Fatal.	Seri-ous.	Fatal.	Seri-ous.	Fatal.	Seri-ous.
1. East Coolgardie ... ..	9	5	...	2	1	2	2	128	...	49	12	186
2. Mt. Margaret ... ..	...	...	...	1	...	1	...	44	...	18	...	64
3. Coolgardie ... ..	...	...	...	1	...	...	1	...	...	...	1	1
4. North Coolgardie ... ..	...	...	1	...	...	...	1	...	...	...	2	...
5. North-East Coolgardie ... ..	...	...	...	...	...	...	...	...	...	...	...	...
6. Broad Arrow ... ..	...	...	...	...	...	...	...	...	...	...	...	...
7. Dundas ... ..	...	1	...	...	...	...	2	...	...	1	2	2
8. Yilgarn ... ..	1	1	...	...	...	...	...	...	...	...	1	1
9. Murchison ... ..	...	...	...	2	1	...	...	15	...	7	1	24
10. East Murchison ... ..	1	4	...	8	...	1	1	45	...	20	2	78
11. Peak Hill ... ..	...	...	...	...	...	...	...	...	...	...	...	...
12. Yalgoo ... ..	...	...	...	...	...	...	...	...	...	...	...	...
13. Northampton ... ..	...	...	...	...	...	...	...	...	...	...	...	...
14. Greenbushes ... ..	...	...	...	...	...	...	...	...	...	...	...	...
15. Swan ... ..	...	...	...	...	...	...	...	...	...	...	...	...
16. Phillips River ... ..	...	...	...	...	...	...	...	...	...	...	...	...
17. Collie ... ..	...	1	1	37	...	...	...	134	...	18	1	190
18. Pilbara ... ..	...	...	...	...	...	...	...	...	...	...	...	...
19. West Pilbara ... ..	...	...	...	...	...	...	...	...	...	...	...	...
20. Ashburton ... ..	...	...	...	...	...	...	...	...	...	...	...	...
Totals for 1933 ... ..	11	12	2	51	2	4	7	366	...	113	22	546
Totals for 1932 ... ..	1	9	10	41	...	4	2	248	4	78	17	380

#### SERIOUS ACCIDENTS.

A large number of these accidents were not actually of a serious nature, but as they necessitated men being away from their work for more than 14 days, had to be classed as such. The more serious accidents, such as breakages of bones, permanent injury to limbs, and injuries which would cause lasting disabling effects, were very carefully investigated by the Inspector of Mines.

#### WINDING MACHINERY ACCIDENTS.

Eleven accidents to winding machinery, which included two skip derailments, six overwinds, and three miscellaneous accidents, were reported during the year.

*Skip Derailments.*—One derailment was found to be due to the dislodging of a roller and its bearing. This projected upwards sufficiently to foul the skip. The bearer had evidently been caught and dislodged by the lash of the rope on the preceding trip.

In the other instance the skip came off at a joint in the rails, but there was no evidence to show what caused it to leave the road.

*Overwinding.*—Six overwinds occurred, and only slight damage resulted except in one case where considerable damage was done to the headgear. All these cases were fully inquired into by the Engine Drivers' Board.

*Miscellaneous.*—Careful inquiries were made into three miscellaneous winding accidents, as under:—

The breaking of a butterfly hook caused an empty skip to fall to the bottom of shaft. It is assumed that a flaw existed in one of the plates. After careful inquiry, no evidence of neglect or carelessness was found.

A nut on shackle bolt became loose and worked off during bailing operations. A tank of water fell

and caused considerable damage to the shaft. It was recommended that pin holes be put in all bolts attached to bailing tanks and split pins used to prevent nuts coming off.

A descending skip came out of the runners, and the ascending skip caught a loop of the rope. Three worn skids were replaced and 80 feet of rope cut off and rope re-shod.

#### ADMINISTRATION.

##### Amendments of Acts.

*"The Mines Regulation Act, 1906."*—Cancellation of Regulations 6a, 6b, 6c, 6d, and 6e; and the Forms A, B, C, D, E, F, and new regulations substituted 6a, 6b, 6c, 6d, 6e, 6f, 6g, 6h, 6i; also in the appendix Forms A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P (Gazetted 6th January, 1933).

Amendment of Regulation 7 (Clause 1) and Form A in the appendix thereto—Medical examination of winding engine drivers. (Gazetted 17th February, 1933.)

Addition of General Rule 49 under Regulation 4—Internal Combustion Engines. (Gazetted 26th May, 1933.)

Substitution of the third paragraph of Regulation 6d, and Form H in the appendix thereto. (Gazetted 30th June, 1933.)

Substitution of Clause 4 under Division 2 of Regulation 15—Workmen's Inspectors of Mines. (Gazetted 28th July, 1933.)

*"The Mining Development Act, 1902-1924."*—Substitution of Regulation 8 of the Regulations under which ore will be crushed and tailings purchased at the State Batteries. (Gazetted 22nd September, 1933.)

*Prosecutions.*

Two men were prosecuted and fined 5/- each for firing shots at a time not specified under Regulation 4, Rule 47, of "The Mines Regulation Act, 1906." The purpose of the prosecution was not to inflict a heavy penalty on the men, but more particularly to make it generally known that fixed times were provided for firing in order to avoid unnecessary fouling of the atmosphere of a mine.

In another case, a contractor was fined £7 and costs for breach of Section 32 (3) (u) for neglecting to take necessary precautions when firing out holes, with the result that two men were injured.

Other instances of alleged breaches of the Act were very carefully investigated, but the circumstances did not warrant the persons concerned being prosecuted.

*Exemptions.*

Twenty-five certificates were issued in accordance with the provisions of Section 31 (4) for exemption from the provisions of Section 31, Sub-Section 1 (b) of "The Mines Regulation Act, 1906."

*Sunday Labour.*

During the year, no permits were granted for carrying out Sunday work.

*Loans and Subsidies.*

The following monetary assistance was given to the Mining Industry:—

	£	s.	d.
Advances towards development work and equipment of mines .. ..	151	19	2
Providing transport and general assistance to prospectors .. ..	30,709	3	2
Amount advanced to Unemployment Relief Department for sustenance to unemployed engaged prospecting ..	5,905	18	2
Cartage subsidies paid to prospectors on ore treated at State Batteries, crushing charges (for low grade ores) .. .. .	12,925	13	1
Subsidies paid to privately owned batteries .. .. .	474	11	7
Miscellaneous expenditure .. ..	640	1	2
	<hr/>		
	£50,807	6	4
	<hr/>		

The total expenditure was £50,807 6s. 4d., compared with £24,089 10s. 8d. during 1932, and £30,545 8s. 4d. during 1931. (Appendix No. 1.)

No expenditure was incurred during this year on Diamond Drill Boring or "Advances on Ores."

## MINING.

The continued high price of gold has stimulated the gold mining industry all over the State, and has permitted lower grade ores to be profitably mined. It is pleasing to be able to record a substantial increase in the tonnage of ore treated and in the amount of gold won each year since 1929. At the same time, the grade of the ore treated has fallen

gradually since 1930. The actual figures are as follows:—

Year.	Ore treated.	Total gold yield.	Average value, dwts. per ton.
	tons.	fine ozs.	dwts.
1929 ...	628,400	377,176	12·00
1930 ...	645,344	419,767	13·00
1931 ...	982,163	518,045	10·55
1932 ...	1,327,021	599,421	9·03
1933 ...	1,588,979	636,928	8·02

Another very satisfactory feature of the gold mining position to-day is the notable advance made in mining and metallurgical practice at our principal mines, resulting in a material reduction in working costs.

The modern appliances introduced during the year include the Morgans Hot Miller, which has increased the drill sharpening rate quite considerably, and the Eimeo-Finley truck loaders, which have speeded up the removal of dirt from development ends.

The old dry crushing plants are gradually being replaced by modern wet crushing ones, the latest addition being the flotation plant at present under construction at the Great Boulder Mine.

*Dust and Ventilation.*—The careful attention given by our staff to the ventilation and sanitation of the mines during the year has resulted in improved working conditions. The improvement effected in ventilation has been due firstly to getting the air under better control, and secondly, to the regulation of firing times. All development ends are ventilated by means of blowers as now required by our regulations. These blowers and the regulation of firing times have materially assisted in keeping the working faces free from dust and fumes.

Nevertheless, Mr. W. Phoenix, our Senior Inspector of Mines, has drawn attention to the fact that the volume of air passing through the mines at Kalgoorlie in recent years has been decreasing rather than increasing, whereas on the Rand Mines the volume of air entering the mines is now two and a half times greater than in 1926. He quite rightly urges that the principal deep mines should now give serious consideration to the question of increasing ventilation by mechanical means.

*Kalgoorlie Mines.*—The increased activity at our principal gold mining centre is evidenced by the increased amount of underground development work carried out, the figures for seven companies being as follows:—Driving, 26,671 feet as compared with 18,948 feet for the previous year; Crosscutting, 18,868½ feet compared with 6,984 feet; Rising and Winzing, 9,367 feet, compared with 7,472; and Diamond Drilling, 15,568½ feet, compared with 10,316; making a total of 70,897 feet compared with 43,720 feet. Brief details of the operations of the principal mines are as follows:—

*The Great Boulder Proprietary* carried out useful development work and materially increased their ore reserves particularly at the northern or Hamilton Shaft end of the property where the X Lode has developed satisfactorily, and also at the southern end where large tonnages of ore have been made

available between Edwards and Lane Shafts. On the surface, the drill sharpening shop has been remodelled and a modern flotation plant having a capacity of 12,000 tons a month is now in the course of erection.

The *Boulder Perseverance Limited* had some good developments underground, and the directors have been so satisfied with the operations of the bromocyanide treatment plant, that they are duplicating the plant so that it will have a capacity of 15,000 tons per month. The second unit is now in the course of erection and is expected to be completed during this year when ore from the North Kalgurli G.M. will also be treated at this plant. An electrically driven 4 inch three throw pump has been installed at the 1700ft. level to pump all underground water flowing into the property directly to the surface.

The *South Kalgurli Limited* operated their plant continuously and carried out 10,917 feet of development work including 3,467 feet of diamond drilling. Indifferent success only was met with on their own lease, but at the Croesus Proprietary, which they are also working, a lode averaging about 15 feet in width has been driven on at the 1,200ft. level.

The *Associated Mine* also operated their plant continuously. No development of special interest occurred.

The *North Kalgurli Mine* continued to develop very satisfactorily. The bottom level (960ft.) is now being driven. The monthly output has been increased during the year to 3,500 tons, and a further increase is contemplated.

The *North Kalgurli Central Company* has begun operations on its leases which adjoin the Croesus Proprietary on the North and the Paringa on the South. A main three compartment shaft has been unwatered and re-equipped to the 400ft. level. Inspector Gibbons reports that a lode 12ft. in width and stated to assay 6 dwts. per ton has been located in an east crosscut at the 87ft. level, and that at the 400ft. level an east crosscut has also passed through a lode.

At the *Paringa Mine*, a diamond drilling programme is in progress. The manner in which the market value of this property has risen would suggest that a measure of success had been met with.

The *Broken Hill Proprietary Company* completed the erection of a small treatment plant, having a capacity of 50 tons a day, at the Hannans North Mine. The plant, which consists of a ten-head battery, a tube mill and a decantation plant, has run continuously and satisfactorily since its completion, and the Company now proposes to sink the main shaft from 600 feet to 800 feet and develop the lode at that depth.

The Company has also decided to exercise its option over the Enterprise Group of Leases, which at the southern end adjoin the South Kalgurli G.M., on the western side and at the northern end, adjoin the North Kalgurli G.M., also on the western side. During the year, two lodes were developed in the Enterprise Lease at a depth of 1,500 feet, while the owners worked what may or may not be another lode down to a depth of 500 feet.

The *Lake View and Star Limited* treated 442,319 tons of ore for a recovery of 164,101.95 fine ozs. of gold, an output which was the highest in the State, and was rivalled only by the Wiluna Gold

Mine. The Company's operations have been described by Inspector Gibbons in his Annual Report as follows:—

The production from this group has been steadily increasing during the year and the output now approaches 45,000 tons per month.

The Chaffers Shaft has reached a depth of 3,500 feet and a considerable amount of lateral development has been carried out on the Nos. 2, 3 and 4 lodes. At the 1,200ft. level, Chaffers section, the Nos. 2 and 4 lodes south drives are being pushed on to connect with the bottom workings of the Hannans Star Mine. A considerable amount of water will have to be handled before the connection is made, and in order to cope with the position a pilot bore hole has been put out from the 1,200ft. level and the workings are now being drained through this hole at the rate of 150,000 gallons per day.

This water gravitates along the 1,200ft. level to a sump near the No. 2 Shaft, Horseshoe section. From this sump the water is pumped direct to the surface by means of a 4in. three-throw horizontal pump driven by Tex ropes from a 60 h.p. electric motor.

The management anticipates having the connections and all preparations for pulling ore from the Hannans Star completed by the end of June. When the drainage bore first cut the water-bearing zone the pressure registered was 240 lbs. per square inch; the gauge now records 175 lbs. per square inch.

It is anticipated that this lease, at depth, will contribute very considerably to the future ore reserves of the Company. All the known "shoots" on the Nos. 2, 3 and 4 lodes have a steep pitch to the south, and therefore their continuity at depth might be expected in this area.

An interesting development occurred during the year on the old Lake View Lease where a cross lode running practically at right angles to the general trend of the existing ore bodies was intersected at the 1,200, 1,400 and 1,600ft. levels. Although the extent and value of this ore body has not yet been proved, nevertheless the discovery is interesting.

An extensive programme of development work has been planned for 1934, and the end of this year should see the Chaffers Shaft down to 3,800 feet below the surface.

This level will be the greatest depth yet attained in Western Australian mining, exceeding that of the Patterson Shaft, Ivanhoe Mine, which has reached a vertical depth of 3,640 feet.

The power house of this company has been extended during the year and a spacious well lighted and cool engine room now houses four (4) 1,100 B.H.P. Crossley Premier heavy oil engines direct coupled to alternators and four (4) 500 B.H.P. Crossley Premier oil engines direct coupled to Bellis and Morcom air compressors, each of the latter having a capacity of 2,000 cubic feet of free air per minute.

The aggregate h.p. of these units approximates 6,400 B.H.P.

Several interesting appliances have been introduced into the mines during the year. Included amongst the more important of these is the "Eimco-Finley" mechanical loader. This machine, which takes the form of a power shovel, operated by compressed air, is very compact in design. It may be operated in a 7ft. x 6ft. drive and can be moved from level to level in any standard cage. The capacity of the loader naturally depends on the supply of empty trucks available, but under average working conditions in a 7ft. x 6ft. drive an end can be "bogged out" in three hours (approximately 20 tons). These machines are operating at Wiluna and Lake View and Star Limited.

Greater efficiency has been achieved in the drill sharpening shop by the installation of the Morgan Hot Miller, a machine taking the form of a type of emery wheel constructed of special material. With the miller in operation the work of the drill sharpening machine is confined to "dumping up" the steel and gauging the bits. Cutting edges and clearances are effected on the "miller."

The management of the Lake View and Star claim this machine has not only resulted in the production of a better class of bit, but the drill-sharpening operations have been reduced from 12 sharpener-shifts to 4 sharpener-shifts.

For exploration work underground the company recently purchased a Mitchell (one man) diamond drill. This handy machine, which is very compact in structure, may be mounted on an ordinary machine bar and operated by one man. The capacity of the drill for horizontal holes is 300 feet; the core produced is 13/16 in. diameter. The crown is set with ordinary "bortz" and cost per foot for "stones" averages about 9d. The total cost of operating, including depreciation and all items, is covered by 6s. per foot.

The average advance recorded, including all stoppages and moving time, approximates 18 feet per day (16 hours).

*Gold Mines in other Mining Centres.*—In last year's Annual Report, only two mines, outside of the Kalgoorlie District, viz:—the Wiluna Gold Mines at Wiluna, and the Sons of Gwalia Mine at Leonora, were included in a description of the important mines of the State. In this report, a brief description is given of six others which now deserve mention, and there is every reason to expect that by next year a number of others will be claiming attention.

*The Wiluna Gold Mines Limited* treated 437,456 tons of ore which yielded 116,201.39 fine ounces of gold. An active programme of development was continued. Last year we reported that the shaft had been completed to the 800ft. level. This year, Inspector Rockett, in his Annual Report, mentions that the workings at the 1,000ft. level and below continue to open up satisfactorily. He goes on to say that the shaft has reached an approximate depth of 1,200ft., and that as soon as the ore pockets and plat are finished, sinking will be resumed. On the surface, the additions to the plant include another 300 h.p. compressor and two Premier oil engines, each 800 h.p. There is, however, still no margin of power, and further additional power plant is contemplated. Inspector Rockett has drawn reference to the fact that this mine has only one operative shaft, through which 300 men a shift are transported, all underground services are performed and an average monthly output of 42,000 tons is hauled. This is said to be a world's record.

Cyclone dust collectors have been installed to deal with the dust from the crushing plant and have functioned efficiently. In the Arsenic Recovery Plant, the Cottrell dust precipitator is now also working satisfactorily.

*Sons of Gwalia, Limited.*—This mine ran continuously and generally had a prosperous year. The shaft was deepened to the No. 27 level which is now being driven. No. 26 level is being opened up, and winze sunk to the horizon of the No. 27 level. Lateral developments have also been satisfactory. The ventilation of the mine has been much improved by the installation at the No. 26 level of an electrically driven fan, having a capacity of 90,000 cubic feet per minute.

Skip derailments have fortunately decreased and none were of a serious nature.

*The Phoenix Mine at Norseman* which was formerly called the "Mararoa," and has produced a total of 340,507 tons of ore for a yield of 169,206 fine ounces of gold, is now under option to the Western Mining Corporation, who are employing some 45 men, principally on exploration work.

*The Norseman Gold Mine*, which adjoins the Phoenix mine, has developed well, and has now be-

come a regular producer employing about 50 men. A ten-head battery has been erected, and the question of increasing the capacity of the plant is under consideration.

*The Lancefield Gold Mine* at Laverton which has to its credit a production of 941,425 tons of ore, yielding 360,139 fine ounces of gold, but which has been idle for a number of years, is now being unwatered, and gives promise of again becoming a producer on a fairly large scale. On the surface, preparations are being made for the erection of a modern flotation plant, having a capacity of 10,000 tons per month.

*The Triton Gold Mine*, situated at Reedy's in the Cue District, was purchased by the Triton Gold Mine Co., N.L., after an extensive diamond drilling campaign. The bores previously put down by the Department proved the lode to maintain its values at a depth, and as the Company's bores have now proved considerable lateral extension, the mine may now be opened up with a measure of confidence. Development is now being pushed on as rapidly as possible. This mine has all the appearance of developing into an important property.

*The Ingleston Consols Mine* at Meekatharra ran continuously and crushed 41,516 tons for 9,096.24 fine ounces of gold. Inspector Rockett reports that it looks well and that at one place in the No. 11 level, payable ore was met with for a width of over 100 feet. Preparations are now being made to sink the shaft another lift of 100 feet.

*Hill 60 Gold Mine* at Mount Magnet, formerly operated by a syndicate employing 11 men, has been purchased by the Mount Magnet Gold Mining Co., who are now employing 70 men. A new shaft equipped with a head frame and winder is now in progress, and at the end of the year had reached a depth of approximately 200 feet.

The ore body has very considerable width and lateral extent, and the Company now proposes to ascertain its value at a depth of 300 feet which will be in the sulphide zone.

#### COAL MINING.

Coal mining was again confined to Collie. Five mines operated during the year, viz:—The Co-operative, Proprietary, Cardiff, Stockton and Griffin Mines. The output was 458,399 tons, or an increase of 42,680 tons over the year 1932. The average number of men employed was 626, or an increase of 22. The serious accidents amounted to 190, as compared with 124 last year, and there was unfortunately one fatal accident. Good working conditions were maintained in the mines. No permits for work on Sundays were issued and there were no prosecutions for breaches of the Coal Mines Regulation Act.

At the Co-operative Mine, a large amount of development work was carried out. Haulage machinery was obtained and preparations generally were made for a large output. The coal so developed has a satisfactory calorific value, but is unacceptable to the Railway Department owing to heavy clinking. At the Proprietary Mine, two attempts were made to prove the coal beyond the fault referred to in our last report by driving back headings down parallel to the main dip, but in each instance the work had to be discontinued owing

to a heavy inflow of water. Development work is now proceeding on the eastern side of the mine. The Cardiff Mine is in fairly good shape, but only averaged about three days' work per week, owing to the limited amount of its class of coal that is saleable. At the Stockton Mine, the main dip was not continued, but a slant heading was started which will be carried as far as the fault met with in the main dip. At the Griffin Mine the main dip was continued. Faults on the left hand side necessitated extra work to get working places in order. There has been a better demand for coal from this mine.

#### GENERAL.

The production of metals and minerals other than gold and coal was again small owing to the low prices prevailing. Arsenic was the most important. It is obtained as a by-product at a special plant at the Wiluna Gold Mine, and the production this year had a value of £36,753 as against £26,161 last year. A little more asbestos was obtained. The others do not call for any special mention.

The price of gold for the year averaged 153s. 9d., and in the month of October reached its record high price of 164s. 3¼d. in Australian currency. This unprecedentedly high price naturally gave rise to increased activity in the search for new mines, and to the re-opening of old ones.

In this respect, the Western Mining Corporation has been prominent. This company has introduced a method of prospecting quite new to this State,

namely that of locating ore bodies by means of aerial photography. Aerodromes have been built, offices and staff quarters erected, and an aerial survey commenced. The same company has spent a very large sum of money on the investigation of properties by geologists of high standing, and during the year exercised its option over the Triton Mine, to which reference has already been made.

Many other companies have continued in search of suitable properties, amongst whom should be mentioned: The Broken Hill Proprietary Co., The Anglo-Australian Gold Mines, Bewick Moreing and Co., and the Gold Fields Australian Development Company.

Constant inquiries were made during the year for reports and other information in the possession of the Mines Department which in a great many instances we were fortunate enough to be able to supply.

The value of large scale operations of modern methods now appears to be generally recognised. A more active policy of underground development is now being carried out than has been for many years, and lastly, it is pleasing to be able to record that our principal mines, which a few years ago were behind the times, are now being equipped on modern lines, and that their mining and metallurgical practice has reached a standard comparable with the best practice in other parts of the world.

RICHARD C. WILSON,  
Acting State Mining Engineer.

#### APPENDIX No. 1.

##### MINING DEVELOPMENT EXPENDITURE.

		£	s.	d.			£	s.	d.
Advances outstanding, 31st December, 1933:—					Interest paid prior to 1933	...	23,160	15	3
Advances authorised prior to 1933	...	238,716	18	0	Interest paid during 1933	...	1,631	13	5
Advances authorised during 1933	...	151	19	2			£24,792	8	8
		£238,868	17	2	Interest outstanding at 31st December, 1932	...	19,133	3	6
Principal money advanced:—					Interest outstanding at 31st December, 1933	...	18,719	6	8
Prior to 1933	...	212,288	5	10	Principal Moneys Advanced	...	£215,430	7	1
During 1933	...	3,142	1	3			£	s.	d.
		£215,430	7	1	Less Principal Moneys repaid	49,298	8	3	
Principal Moneys repaid (including sale of Securities)—					Less Bad Debts written off	...	42,832	13	3
Prior to 1933	...	46,692	2	6			92,131	1	6
During 1933	...	2,606	5	9	Principal outstanding at 31st December, 1933	...	123,299	5	7
		£49,298	8	3	Interest outstanding at 31st December, 1933	...	18,719	6	8
Bad Debts written back and amounts transferred:—							£142,018	12	3
Prior to 1933	...	40,535	4	10					
During 1933	...	2,297	8	5					
		£42,832	13	3					

## APPENDIX No. 2.

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*Coal Mines Regulation Act, 1902-1926.*

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

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Office of the State Mining Engineer,  
Mines Department,  
Perth, 20th April, 1934.

*The Under Secretary for Mines.*

Sir,

We submit herewith, for the information of the Hon. Minister for Mines, the Annual Report of the Board of Examiners for the year 1933.

*Examinations for Certificates.*

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

*Meetings.*

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

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

We have the honour, &c.,

R. C. WILSON,  
Acting State Mining Engineer,  
(Chairman).

T. BLATCHFORD,  
Government Geologist,  
(Member).

J. McVEE,  
Inspector of Mines, Collie,  
(Member).

V. RUSSELL,  
Secretary.

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## DIVISION III.

### Report of the Superintendent of State Batteries.

*The Under Secretary for Mines.*

I have the honour to submit for the information of the Hon. Minister my report on the operations at State Batteries for the year ended 31st December, 1933.

The total tonnage handled in both sections of our plants was 175,767, made up of 91,616 milled and 84,151 cyanided. This is an increase on the previous year of 33,806.25 tons and the highest output since 1909, and is within striking distance of the record tonnage in 1906.

The following figures show the striking increase in prospecting activity:—

Year.	Tons Milled.		
1906	...	...	95,831 (Record year)
1928	...	...	16,274.25 (Lowest year)
1933	...	...	91,616

#### *Value of Ore.*

Inclusive of incomplete crushings from the previous year 91,834 tons yielded by amalgamation 53,012.7 ounces of bullion, estimated to contain 44,935.4 fine ounces and equal to 9.785 dwts. per ton, and the average value of the tailing produced was 4.177 dwts. The total value of the ore was 13.962 dwts. per ton, or 59s. 4d. with gold at 85s. per ounce. The values for 1932 and 1931 were 59s. 10d. and 57s. 9d. respectively.

The highest grade ore was produced as in the previous year at Bamboo, the estimated value per ton being £6 8s. 3d. Marble Bar, £5 0s. 7d.; Ora Banda, £4 7s. 3d.; and Meekatharra, £4 3s. 8d., based on the par value of 85s. per ounce, are all excellent yields.

At Peak Hill 6,185 tons were crushed at a value of £1 6s. 2d. per ton.

Details of all batteries are shown in Schedule 3.

#### *Value of Production.*

The estimated actual value of bullion recovered, including premium added to the actual value produced by our tailing plants, was £459,743. A comparison with the two previous years is as follows:—

1931.	1932.	1933.
£224,214	£387,869	£459,743

#### *Average Extraction.*

The average value of ore treated was 13.962 dwts.

Owners received 9.785 dwts. per ton by amalgamation, equal to 70.07 per cent.

The whole of the current year's tailing was not treated, but by applying the average extraction of 77.10 per cent. obtained to the average value of tailing produced, viz., 4.177, the extra gold recovered would be 3.220 dwts., or a total of 13.005 dwts. per ton, equal to 90.3 per cent. recovery.

This figure is considerably below the 1932 figure, and is due to the lower percentage recovery by amalgamation. It is still a satisfactory figure when the nature of the ore now forthcoming is taken into account, and shows an estimated residue value of 0.960 dwts.

#### *Receipts and Expenditure* (1932 figures in brackets).

Expenditure amounted to £80,785 6s. 6d. (£72,913 10s. 2d.) and receipts were £110,160 17s. 1d. (£87,068 16s. 11d.), showing a net profit of £29,375 10s. 7d. (£14,155 0s. 9d.).

Details are shown in a comparative synopsis later in this report.

#### MILLING.

Exclusive of one 10-stamp and three 5-stamp mills leased, five 10-stamp and 16 5-stamp mills were available for public crushing and treated 91,616 tons of ore for a yield of 53,012.7 ounces of bullion by amalgamation.

There was no increase in the number of stamps, but the tonnage milled increased by 11,870.25 tons and the yield by 3,501.3 fine ounces.

The tonnage crushed was the highest since 1910, and was only 4,012 tons less than the peak year 1908.

The number of parcels treated was 2,338, an average of 39.1 tons, as against 2,117 parcels and 37.6 tons in 1932.

Batteries crushing over 5,000 tons were as follows:—Kalgoorlie, 12,683¼ tons; Coolgardie, 11,276¾ tons; Cue, 9,880½ tons; Ora Banda 7,854¾ tons; Peak Hill, 6,185½ tons; Meekatharra, 5,426¼ tons; and Boogardie, 5,363¼ tons.

Increased tonnages were milled at all the North-West batteries and Mt. Ida, Payne's Find, and all outback centres, except Youanmi, St. Ives, Wiluna, and Warriedar.

#### *Stamp Duty.*

The average stamp duty for all plants was 4.08 tons per 24 hours, with best figures at Yalgoo, 5.65; Ora Banda, 5.49; Peak Hill, 5.39, and Kalgoorlie, 5.08. These figures are satisfactory considering only screens with 900 holes to the square inch were used.

#### *Fuel Consumption and Cost per B.H.P.*

##### *Steam Plants.*

We have only four steam-driven plants in operation, and the consumption of fuel varied from 8.45 to 12.22 lbs. per h.p.h. and costs from 0.67 pence at Coolgardie to 1.10 pence per h.p.h. at Laverton.

##### *Charcoal Producer Plant.*

These are being gradually replaced by wood producers, but seven plants still burn charcoal, and the consumption varied between 1.4 and 1.51 lbs. per h.p.h. and cost from 0.52 pence at Mt. Ida to 1.51 pence at Marble Bar. This plant was scrapped during the year and replaced by a crude oil power unit.

##### *Wood Producer Plants.*

The figures were generally good, though the ever-growing scarcity of good wood is reflected in the consumption at most plants.

Consumption ranged from 3.00 lbs. at Sandstone to 6.03 lbs. per h.p.h. at Bamboo Creek, where the timber is of low value, and costs varied from 0.25 pence to 1.08 pence per h.p.h. (Bamboo Creek).

Comparative tests on different classes of wood were undertaken at Kalgoorlie and Ora Banda, and though completed since the close of the year, I am appending the results to this report.

#### Crude Oil.

Marble Bar and Yalgoo, the only two oil-driven plants, of totally dissimilar types, show similar consumption figures, viz., 0.472 pints and 0.448 pints per h.p.h. respectively, and costs in favour of Marble Bar. The old charcoal costs of 1.51 pence per h.p.h. were reduced to 0.57 pence with crude oil.

#### Milling Costs and Revenue.

The cost per ton, including administration and all charges such as insurance, was 11s. 6.7d. and revenue 9s. 6.5d. respectively, as against 12s. 6.36d. and 9s. 9.04d. in 1932. The decrease in both cost and revenue is partly due to the same factor, namely, higher efficiency and the consequent increased output per hour, allowing customers to take full advantage of time crushing.

Our present system of charges is rather an anomalous one in so far that irrespective of the expenditure incurred in increasing the efficiency of our plants the Department can only benefit to a fixed extent, as when the owner finds the output of a plant justifies his engaging it by time, 8s. 6d. per hour is fixed as the maximum revenue for 5-head of stamps, whilst the owner may crush for as low as 5s. per ton, and where water is expensive the cheaper the crushing to the owner the greater the expense to the Department.

This is exemplified at Coolgardie, Kalgoorlie, and Ora Banda, which, with the exception of Cue, have the largest outputs, and where the cost of water is great.

The decrease of 1s. per ton can be considered satisfactory in view of the fact that general increases in wages were given for the last two months of the year and the Forestry's Department's collection of

firewood and charcoal royalties, which have been reflected in the increased cost of fuel.

#### Repairs and Renewals.

These were paid from working and were also very heavy, amounting to £4,705 8s. 4d.

#### TAILING TREATMENT.

Of the 21 mills operating, tailing treatment was carried on at 17. Mt. Ida and Marble Bar produce refractory tailing due to the presence of copper, and Payne's Find and Youaumi were the only other plants where no tailing was handled. 84,151 tons were treated, which was slightly more than the output from the batteries, accumulations being drawn upon.

With the exception of the tailing at Mt. Ida and Marble Bar, practically the whole of the tailing was purchased, notwithstanding the more or less refractory nature of a fair percentage.

The use of saturated lake water at St. Ives and Norseman resulted in low extraction, and at Boogardie the large amount of ironstone gave a fairly high residue.

The presence of this tailing and the necessity for treating through the winter months when difficulty is experienced in drying the material properly, has resulted in lower extraction being obtained, and the average extraction for the year was 77.10 per cent.

The average value of the 84,151 tons treated was 4.43 dwts., and the residue 1.012 dwts.

14,770.41 fine ounces were recovered, valued in Australian currency at £112,890.54.

#### Receipts and Expenditure.

Receipts amounted to £66,293 4s. 9d. and expenditure to £27,825 4s. 9d., leaving a profit of £38,468.

Cost per ton declined from 6s. 11d. to 6s. 7.3d. and receipts increased from 14s. 6d. in 1932 to 15s. 9.7d., due to the increased premium received.

The cost figure is quite good considering the increased tonnages treated at expensive centres like Bamboo Creek and Jimble Bar.

Comparative Synopsis of Results at State Batteries for 12 Months ended 31st December, 1932 and 1933.

	1933.			1932.		
	Tonnage.	Expenditure.	Revenue.	Tonnage.	Expenditure.	Revenue.
Milling ... ..	91,616	11/6.7	9/6.5	79,745.75	12/6.36	9/9.04
Tailing Treatment ...	84,151	6/7.3	15/9.7	66,216	6/11	14/6.6

#### Receipts and Expenditure.

	Tonnage.	Expenditure.	Revenue.	Profit.	Loss.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.
Milling ... ..	91,616	52,934 0 7	43,865 12 4	...	9,068 8 3
Tailing ... ..	84,151	27,825 4 9	66,293 4 9	38,468 0 0	...
Tin Treatment ... ..	...	26 1 2	2 0 0	...	24 1 2
	175,767	80,785 6 6	110,160 17 1	38,468 0 0	9,092 9 5
			Less Loss ...	9,092 9 5	
			Net Profit ...	£29,375 10 7	



### ADDITIONS AND RENEWALS.

During the year two erection engineers were more or less continuously employed on the above-mentioned work, and though no new batteries were erected £10,545 3s. was expended on new tailing plants and additions to others, installation of electric light, reconstruction of plants, rent of Kalgoorlie battery, etc., and at the end of the year most of our plants were in good condition, notwithstanding their age and long idleness.

The cost of this work was as follows:—

<i>Assistance to Gold Mining Industry—</i>		£	s.	d.	£	s.	d.
Wages ... ..	688	0	0				
Interdepartmental ...	602	0	0				
Other (including rent of Kalgoorlie State Battery) ... ..	3,463	16	3				
					4,753	16	3
<i>General Loan Fund—</i>							
Wages ... ..	1,435	14	6				
Interdepartmental ...	1,755	12	3				
Other ... ..	2,600	0	0				
					5,791	6	9
					£10,545	3	0

Amongst the most important work was the installation of crude oil engine and electric generator at Marble Bar, enabling us to drive the well pump for our water supply by motor, and providing electric light, the saving in power and light for the first three months' run being approximately £200.

The engine is portable, and it is intended to use it at Bamboo Creek and run the plants alternately.

The producer gas engine was transferred to Boogardie, and took the place of the worn-out engine. At this centre, and at Peak Hill and Warriedar, electric generators were installed and motors put in for water supply power units.

### CARTAGE SUBSIDIES.

The amount paid in subsidies was £12,935 13s. 1d. as against £13,265 8s. 7d. in the previous year, though the tonnage crushed increased by 11,870.25 tons at State batteries only.

These subsidies now apply to practically all public crushing plants as well as State batteries, and a very considerable amount of work is entailed in policing them.

### ADMINISTRATION.

Details of administration are as follow:—

	£	s.	d.
Salaries ... ..	1,486	14	10
Inspection, including Salary of Inspector ... ..	799	6	1
Insurance ... ..	2,342	5	10
Printing ... ..	121	6	8
Postage, etc. ... ..	176	17	3
	£4,926	10	8

Administration cost per ton dropped from 7.00 pence in 1932 to 6.7 pence, the main increase in any item being insurance, which rose from £1,665 7s. 6d. in 1932 to £2,342 5s. 10d., consequent on all employees being insured against occupational diseases under the Third Schedule of the Mines Regulation Act.

### STAFF.

The appointment of Assistant Manager Thomas in charge of Mt. Ida was the only addition to the gold-fields staff, and no changes were made at head office.

Sixteen managers and assistant managers controlled the plants, and since they dealt with a combined tonnage of 175,767 tons, were very fully occupied.

The difficulty of obtaining the proper type of officer under present conditions and allowing officers to take long periods of leave accumulated during the last few years have made the task of administration a heavy one, but the position has at the time of writing considerably improved. The fact that some of our more responsible managers are approaching the retiring age suggests that, if conditions do not change, this difficult position will again recur. I am endeavouring to obtain technically trained young men as cadets, but it is difficult to hold them.

I have pleasure in placing on record my appreciation of the zealous way the staff, both on the gold-fields and at the head office, has tackled the ever-increasing work and responsibility. A particularly bad summer on the fields has added to the difficulties of officers, and I wish to express my thanks for their loyal support and co-operation.

From September to the close of the year, when I was Acting State Mining Engineer, a good deal of extra work devolved upon the Inspector and Engineer.

### *Assistance to Industry through State Batteries.*

	£	s.	d.	£	s.	d.
Profit on Working ... ..	29,375	10	7			
Less Cartage Subsidy ... ..	12,935	13	1			
Erection and Reconstruction ... ..	10,545	3	0			
				23,480	16	1
				£5,894	14	6

### GENERAL REMARKS.

The year has been a successful one in every way. The tonnage milled was the highest for 24 years, and was within 4,225 tons of the record output in 1906. The profit was a record one, due to the lower working costs, the increased premium received on gold derived from tailing treatment, and the treatment of a certain proportion of accumulated tailing made possible by additions to our tailing plants, the cost of which was borne by loan funds.

A pleasing feature was the maintenance of the grade of ore crushed, which dropped only 6d. per ton at par to 59s. 4d. per ton, an excellent figure. With the premium added the yield for the year increased very considerably over that for 1932, the estimated total being £459,743 as against £387,869 in 1932. Considering the total value for the State for the year was £4,886,254, these figures speak well for the results of the prospectors' efforts, and the maintenance of the high grade of ore suggests that the new prospectors have been quick to grasp the essentials of their new occupation.

With the exception of Youanmi all centres where our batteries operate have shown increased activity, and for the first time for many years we have found it advisable to have a full-time manager in the Pilbara, where very extensive alterations to our plants at Marble Bar and Bamboo Creek were made.

Generally the condition of our plants has improved, though some of the old ones like Laverton are expensive, and the installation of a gas producer plant will have to be considered this year. Almost all

As mentioned before, the consumption per H.P.H. is approximate on account of the difficulty of estimating the power consumed, but the comparison is sound.

It will be seen that gimlet gave the best results of the gum varieties and runs mulga very closely as a green fuel.

#### Test No. 2.

Comparative tests at Ora Banda between semi-dry gimlet and mulga over a period of 436 hours and 487 hours respectively, confirmed the results at Kalgoorlie, the comparative figures being—

Mulga .. .. .	2.73 lbs. per H.P.H.
Gimlet .. .. .	3.16 " " "

#### Test No. 3.

Analysis of the gas generated during the tests at Kalgoorlie was made by the Government Mineralogist and Analyst, Dr. Simpson.

Unfortunately the sample of gas from mulga was contaminated with air, but the results show the close similarity between the gases from the different eucalypti and, in comparison with Edquist, Valentine and Dunstan's Sons of Gwalia tests on mulga, show a generally higher carbon monoxide and correspondingly lower hydrogen content.

The calculated calorific values of the samples of gas taken while the respective timbers were being burnt show interesting results, but must not be taken too literally as these values would vary according to the length of time between charging and when the samples were taken. The gas taken when gimlet was burnt shows the highest figure, namely 135 B.T.U., and this is a reflection of its economical value as shown in Test No. 1, and compares favourably with 132, the higher figure obtained in the Sons of Gwalia test on mulga.

Details of these analyses are as follow:—

Lab. No. ... ..	2999 Salmon Gum.	3000 Gimlet.	3698 Blackbutt.	3699 Redwood.	3700 Mulga.	3701 Whitegum.	Edquist, etc.— Mulga	
Moisture content of timber	24.0—28.9%	21.7—23.0%	17.8—19.6%	21.0%	19.2%	21.9—23.5%	A.	B.
Carbon dioxide ...	10.0	6.9	6.2	6.4	4.9	7.0	14.2	9.4
Oxygen ... ..	.5	.1	.5	.2	5.9	.2	.1	.2
Illuminants ...	...	...	...	...	...	...	...	...
Carbon monoxide ...	20.9	24.1	23.0	24.6	15.4	23.7	15.5	20.8
Hydrogen ... ..	15.1	10.4	5.9	9.8	5.1	7.9	13.8	7.9
Methane ... ..	1.2	2.4	2.3	2.2	2.6	1.5	4.2	3.1
Nitrogen (by difference)	52.3	56.1	62.1	56.8	66.1	59.7	52.2	58.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated calorific value B.Th.U. (gross at 60°F. and 30% moist.) ...	128	135	116	132	92	116	132	122

#### Test No. 4.

Calorific values determined by the Government Mineralogist and Analyst of woods used during the tests at Kalgoorlie:—

Date received ...	21-4-33	10-7-33	10-7-33	29-8-33	29-8-33	29-8-33	29-8-33
Lab. Nos. ... ..	1594	2997	2998	3702	3703	3704	2705
Firewood used ...	Mulga	Salmon Gum	Gimlet	Blackbutt	Redwood	Mulga	Whitegum
Moisture content of wood	Log 4in. dia., 21.3%	Small log 3½in. dia., 26.6% Medium log 5½ in. dia., 28.9% Large log 8½in. dia., 24.0%	Small log 3½in. dia., 21.7% Medium log 4½ in. dia., 23.0% Large log 5½in. dia., 22.4%	Log (smooth bark) 3½in. dia., 17.8% Log (rough bark) 3½in. dia., 19.6% 18.7%	Log 4½in. dia., 21.0%	Medium log 4in. dia., 19.2% Large log 4½in. dia., 19.2%	Medium log 4½ in. dia., 21.9% Large log 5½in. dia., 23.5%
Mean ... ..	21.3%	26.5%	22.4%	18.7%	21.0%	19.2%	22.7%
Air-dried moisture ...	12.73%	9.84%	9.88%	9.89%	9.97%	9.20%	9.76%
Ash (dry basis) ...	2.72%	2.19%	2.88%	2.67%	1.54%	3.20%	1.54%
Calorific value (dry basis), B.Th.U. gross	8816	8357	8352	8154	8325	8790	8403
Calorific value (calcu- lated to mean original moisture), B.Th.U. gross ... ..	6936	6140	6483	6630	6579	7102	6498

#### Comparative Cost of Oil and Wood Fuel.

If capital cost of plant is considered, and in my opinion it should be, the amount allowed for this item will be greater for a producer plant on account of the higher cost of installation.

The amount charged under the heading "Supervision" will also be greater, but would vary so much according to the duties of the attendant and size of plant as to make a correct estimate difficult.

Lubricating oil can best be considered in both kinds of power production as part of the direct cost and is a far heavier one in the case of oil-driven than in producer plants, as the consumption is heavier even when the oil is filtered in the former, and the cost of the lubricant is higher.

Our State Battery experience of crude oil is a comparatively short one, but in centres where the transport charge is £4 per ton, the cost of power so produced is 0.6 pence per H.P.H. as against .035 pence for a similar plant burning wood at the average price of 17s. per ton. These figures take into account the cost of fuel and lubricating oil.

#### Summary.

(1) Previous experience and the tests enumerated have proved that all goldfields timbers, including the well-known varieties of gum, can be burnt successfully off the axe, with the possible exception of redwood, which is a timber of minor importance, and that partially dry wood gives better results.

(2) That in all centres where the transport charges for fuel oil are over £4 per ton and wood fuel can be obtained at 17s. per ton, the use of producer plants would be more economical notwithstanding the extra capital cost and supervision.

(3) With unsoftened mineralised water for cooling purposes, always providing that the scrubber capacity is sufficient and means are taken to dry the gas before going to the engine, water jacket incrustation and overheating are less likely in a producer plant than in a crude oil unit.

(4) Our experience has proved that with varying loads a grate area of 1 sq. foot to 10-15 H.P. is quite satisfactory, as while the consumption of fuel may be a little higher through some being burnt to the air when the lighter load is on, there is sufficient heat generated to effectively break up the fuel and water into its simpler components, whilst it is not intense enough to effect the producer lining or firebars.

#### Conclusion.

It is my considered opinion that, except in more or less remote places, the choice of plants, whether oil or wood driven, becomes a matter of taste, but it has to be borne in mind that where there is no regeneration of fuel supplies by regrowth, such as in the districts dependent on mulga and its varieties, companies erecting large producer plants are liable to soon become embarrassed with long firewood lines with attendant organisation, supervision and capital expenditure, and at the same time the supplies for domestic use are depleted, resulting in an increase in the cost of living, with its incidence on the cost of wages.

In the gum belt, where the regrowth can be burnt in from 25 to 40 years, the question of continuous firewood supplies should present no great concern.

D. BROWNE,

Superintendent of State Batteries.

8th June, 1934.  
D.F.B./P.T.

## SCHEDULE I.

Return showing Number of Tons Crushed, Gold Yield by Amalgamation, Average per Ton in Shillings, and Total Value for Year 1933.

Battery.	Tons Crushed.	Gold Yield Bullion.		Value per Ton.	Total Value.
		Fine ozs.	s. d.		
Bamboo Creek ... ..	1,328·00	1,914·15	103 9·13	6,890·94	
Boogardie ... ..	5,363·25	2,862·30	38 4·89	10,304·28	
Coolgardie ... ..	11,276·75	7,657·35	48 10·76	27,566·46	
Cue ... ..	9,778·50	4,914·40	36 0·23	17,691·84	
Jimble Bar ... ..	2,241·00	799·95	25 8·41	2,879·82	
Kalgoorlie ... ..	12,722·25	5,318·80	30 1·22	19,147·68	
Laverton ... ..	4,773·00	2,473·32	37 3·97	8,903·95	
Marble Bar ... ..	1,793·00	1,949·55	78 3·43	7,018·38	
Meekatharra ... ..	5,406·25	4,760·45	63 4·38	17,137·62	
Mt. Ida ... ..	1,755·50	895·40	36 8·56	3,223·44	
Norseman ... ..	2,997·25	1,730·10	41 6·76	6,228·36	
Ora Banda ... ..	7,823·75	6,675·80	61 5·22	24,032·88	
Payne's Find ... ..	1,830·25	1,430·55	56 3·40	5,149·98	
Peak Hill ... ..	6,271·50	1,734·30	19 10·94	6,243·48	
Sandstone ... ..	4,562·75	2,923·15	46 1·49	10,523·34	
St. Ives ... ..	2,827·75	801·05	20 4·73	2,883·78	
Warriedar ... ..	2,232·00	867·65	27 11·91	3,123·54	
Wiluna ... ..	2,574·75	1,013·95	28 4·21	3,650·22	
Yarri ... ..	1,608·75	1,196·80	53 6·78	4,308·48	
Youanmi ... ..	227·00	33·45	10 7·32	120·42	
Yalgoo ... ..	2,222·75	1,060·25	34 4·08	3,816·90	
Total ... ..	91,616·00	53,012·72	41 8·00	190,845·79	

## SCHEDULE 2.

Tailings Treatment for 1933.

Battery.	Tonnage.	Yield.		Value.	Premium.
		Fine ozs.	£		
Bamboo Creek ... ..	1,380	606·97	2,558·67	2,120·36	
Boogardie ... ..	5,356	1,155·46	5,416·25	3,462·97	
Coolgardie ... ..	13,434	1,737·74	7,452·03	5,904·54	
Cue ... ..	8,195	1,375·33	6,208·69	4,406·18	
Kalgoorlie ... ..	13,500	2,030·13	8,450·71	7,209·97	
Jimble Bar ... ..	2,990	911·30	3,283·74	2,924·69	
Laverton ... ..	2,200	370·53	1,573·79	1,236·34	
Meekatharra ... ..	3,520	812·85	3,568·61	2,588·29	
Norseman ... ..	3,320	485·54	2,080·57	1,628·64	
Ora Banda ... ..	7,725	1,991·74	8,739·04	6,704·39	
Peak Hill ... ..	5,985	455·80	1,936·51	1,558·72	
Sandstone ... ..	4,444	793·86	3,703·69	2,366·97	
St. Ives ... ..	3,772	548·55	2,384·27	1,779·82	
Warriedar ... ..	1,585	299·57	1,291·56	934·41	
Wiluna ... ..	2,405	782·59	3,325·56	2,831·19	
Yarri ... ..	2,970	247·31	1,110·82	843·37	
Yalgoo ... ..	1,370	165·14	701·34	603·84	
Total ... ..	84,151	14,770·41	63,785·85	49,104·69	
£112,890·54					

## SCHEDULE 3.

Return showing Number of Parcels treated and Tons crushed at State Batteries for Year 1933.

No. of Parcels Crushed.	Battery.	Tons Crushed.	Yield by Amalgamation, Bullion.		Yield by Amalgamation, FineGold.		Gross Contents of Tailing (in- cluding refractory tails), Fine Gold.	Total Contents of Ore, Fine Gold.	Average per ton, Fine Gold.	Gross Value per ton.
			ozs. dwt. grs.	ozs. dwts. grs.	ozs. dwt.	ozs. dwt.				
25	Bamboo Creek ... ..	1,328	1,914 3 0	1,622 11 0	433 5	2,055 16	30 5	£ s. d. 6 8 3		
156	Boogardie ... ..	5,363½	2,862 7 0	2,426 4 0	1,532 13	3,958 17	14 18	3 2 8		
357	Coolgardie ... ..	11,276½	7,657 7 0	6,490 16 0	1,866 0	8,356 16	14 19	3 2 10		
223	Cue ... ..	9,880½	4,914 8 0	4,165 14 0	2,163 3	6,328 17	12 19	2 14 4		
20	Jimble Bar ... ..	2,511	799 19 0	678 2 0	584 7	1,262 9	10 1	2 2 8		
394	Kalgoorlie ... ..	12,683½	5,318 16 0	4,508 10 0	2,237 6	6,745 16	10 16	2 5 4		
168	Laverton ... ..	4,773	2,473 5 0	2,096 10 0	886 5	2,982 15	12 12	2 13 1		
68	Marble Bar ... ..	1,843	1,949 11 0	1,652 10 0	539 0	2,191 10	23 16	5 0 7		
130	Meekatharra ... ..	5,426½	4,760 9 0	4,035 4 0	1,310 3	5,345 7	19 17	4 3 8		
28	Mt. Ida ... ..	1,755½	895 8 0	758 18 0	687 17	1,446 15	16 11	3 9 11		
120	Norseman ... ..	2,997½	1,730 2 0	1,466 10 0	601 14	2,068 4	13 19	2 18 7		
127	Ora Banda ... ..	7,854½	6,675 16 0	5,668 14 0	2,434 15	8,093 9	20 14	4 7 3		
43	Payne's Find ... ..	1,380½	1,430 11 0	1,212 12 0	200 10	1,413 2	15 10	3 5 5		
65	Peak Hill ... ..	6,185½	1,734 6 0	1,446 1 0	472 8	1,918 9	6 4	1 6 2		
45	St. Ives ... ..	2,827½	801 1 0	679 0 0	514 10	1,193 10	8 10	1 15 9		
118	Sandstone ... ..	4,562½	2,923 3 0	2,477 16 0	759 6	3,237 2	14 4	3 0 2		
56	Warriedar ... ..	2,182	867 13 0	735 8 0	660 2	1,395 10	12 18	2 14 2		
48	Wiluna ... ..	2,529½	1,013 19 0	859 8 0	690 8	1,549 16	12 6	2 12 0		
101	Yalgoo ... ..	2,282½	1,060 5 0	898 14 0	387 19	1,285 13	11 6	2 7 9		
37	Yarri ... ..	1,513½	1,196 9 0	1,038 0 0	203 16	1,241 16	16 9	3 9 6		
9	Youanmi ... ..	227	33 9 0	28 6 0	23 15	52 1	4 14	0 18 6		
...		91,834	53,012 14 0	44,935 8 0	19,189 2	64,124 10	13 23	2 10 2		

## SCHEDULE 4.

Direct Purchase of Tailings.

Battery.				Tons purchased.	Amount.	
					£	s. d.
Bamboo Creek	...	...	...	846	1,833	8 9
Boogardie	...	...	...	4,073 $\frac{1}{4}$	5,520	1 6
Coolgardie	...	...	...	6,126 $\frac{1}{4}$	5,241	10 10
Cue	...	...	...	5,543 $\frac{3}{4}$	5,879	2 10
Laverton	...	...	...	3,022	2,021	17 3
Jimble Bar	...	...	...	2,019 $\frac{3}{4}$	1,928	17 3
Kalgoorlie	...	...	...	5,880 $\frac{1}{2}$	5,923	3 9
Meekatharra	...	...	...	3,322 $\frac{3}{4}$	3,786	6 9
Norseman	...	...	...	1,937 $\frac{1}{4}$	1,897	2 5
Ora Banda	...	...	...	5,401 $\frac{1}{2}$	7,893	18 4
Payne's Find	...	...	...	839 $\frac{1}{2}$	118	16 10
Peak Hill	...	...	...	884	1,117	6 6
Sandstone	...	...	...	2,168	1,701	17 5
St. Ives	...	...	...	1,959	1,271	7 10
Warriedar	...	...	...	2,075 $\frac{3}{4}$	2,295	6 8
Wiluna	...	...	...	959 $\frac{3}{4}$	2,073	13 2
Yarri	...	...	...	773 $\frac{1}{2}$	727	0 3
Youanmi	...	...	...	165	24	18 7
Yalgoo	...	...	...	1,035 $\frac{1}{2}$	702	17 2
				49,033	51,958	14 1

## SCHEDULE 5.

Return showing Tailing payable and unpayable and Gross Contents for Year 1933.

Battery.	Tailing payable.		Tailing unpayable.		Refractory tailing.		Totals.		
	Tons.	Gross Contents.	Tons.	Gross Contents.	Tons.	Gross Contents.	Tons.	Gross Contents.	
Bamboo Creek	1,133 $\frac{3}{4}$	ozs. dwt. grs. 431 13 0	16	ozs. dwt. grs. 1 12 0	...	ozs. dwt. grs. ...	1,149 $\frac{3}{4}$	ozs. dwt. grs. 433 5 0	
Boogardie	3,731 $\frac{1}{2}$	1,459 16 0	896 $\frac{3}{4}$	72 17 0	...	...	4,628 $\frac{1}{2}$	1,532 13 0	
Coolgardie	6,163	1,535 10 0	3,399 $\frac{1}{4}$	304 12 0	119 $\frac{3}{4}$	25 18 0	9,682 $\frac{1}{4}$	1,866 0 0	
Cue	5,241 $\frac{1}{2}$	1,859 8 0	3,318	303 15 0	...	...	8,559 $\frac{3}{4}$	2,163 3 0	
Jimble Bar	1,926 $\frac{3}{4}$	559 19 0	182 $\frac{1}{2}$	21 4 0	23	3 4 0	2,132	584 7 0	
Kalgoorlie	6,281 $\frac{1}{2}$	1,827 6 0	4,621	400 3 0	42	9 17 0	10,944 $\frac{1}{2}$	2,237 6 0	
Laverton	3,100 $\frac{1}{2}$	780 4 0	1,106	106 1 0	...	...	4,206 $\frac{1}{2}$	886 5 0	
Marble Bar	...	...	...	...	1,580 $\frac{3}{4}$	539 0 0	1,580 $\frac{3}{4}$	539 0 0	
Meekatharra	3,677 $\frac{1}{2}$	1,225 17 0	999 $\frac{3}{4}$	84 6 0	...	...	4,677 $\frac{1}{2}$	1,310 3 0	
Mt. Ida	...	...	...	...	1,515 $\frac{1}{2}$	687 17 0	1,515 $\frac{1}{2}$	687 17 0	
Norseman	2,098 $\frac{1}{2}$	565 10 0	496 $\frac{1}{2}$	36 4 0	...	...	2,595	601 14 0	
Ora Banda	4,721 $\frac{1}{2}$	2,271 6 0	1,978 $\frac{3}{4}$	163 9 0	...	...	6,700 $\frac{1}{2}$	2,434 15 0	
Payne's Find	1,003 $\frac{1}{2}$	153 8 0	584 $\frac{1}{2}$	47 2 0	...	...	1,588 $\frac{1}{2}$	200 10 0	
Peak Hill	883 $\frac{1}{2}$	225 0 0	4,325 $\frac{1}{2}$	234 14 0	18 $\frac{1}{2}$	12 14 0	5,227 $\frac{1}{2}$	472 8 0	
St. Ives	1,927	460 10 0	566 $\frac{1}{2}$	54 0 0	...	...	2,493 $\frac{1}{2}$	514 10 0	
Sandstone	2,457	635 3 0	1,493 $\frac{1}{2}$	121 3 0	...	...	3,950 $\frac{1}{2}$	756 6 0	
Warriedar	1,745	648 5 0	135 $\frac{1}{4}$	11 17 0	...	...	1,880 $\frac{1}{4}$	666 2 0	
Wiluna	2,015	671 13 0	181	18 15 0	...	...	2,196	690 8 0	
Yalgoo	1,052 $\frac{1}{2}$	270 11 0	799 $\frac{1}{2}$	68 18 0	101 $\frac{1}{2}$	48 10 0	1,953 $\frac{1}{2}$	387 19 0	
Yarri	516	109 4 0	593 $\frac{1}{2}$	24 17 0	184 $\frac{1}{2}$	69 15 0	1,294 $\frac{1}{2}$	203 16 0	
Youanmi	98 $\frac{1}{2}$	14 14 0	102 $\frac{1}{2}$	9 1 0	...	...	200 $\frac{1}{2}$	23 15 0	
		49,774 $\frac{1}{2}$	15,704 17 0	25,796 $\frac{1}{4}$	2,084 10 0	3,585 $\frac{1}{2}$	1,396 15 0	79,156 $\frac{1}{2}$	19,186 2 0

## SCHEDULE I.

Return showing Number of Tons Crushed, Gold Yield by Amalgamation, Average per Ton in Shillings, and Total Value for Year 1933.

Battery.	Tons Crushed.	Gold Yield Bullion.		Value per Ton.	Total Value.
		Fine ozs.	s. d.		
Bamboo Creek ... ..	1,328·00	1,914·15	103 9·13	6,890·94	
Boogardie ... ..	5,363·25	2,862·30	38 4·89	10,304·28	
Coolgardie ... ..	11,276·75	7,657·35	48 10·76	27,566·46	
Cue ... ..	9,778·50	4,914·40	36 0·23	17,691·84	
Jimble Bar ... ..	2,241·00	799·95	25 8·41	2,879·82	
Kalgoorlie ... ..	12,722·25	5,318·80	30 1·22	19,147·68	
Laverton ... ..	4,773·00	2,473·32	37 3·97	8,903·95	
Marble Bar ... ..	1,793·00	1,949·55	78 3·43	7,018·38	
Meekatharra ... ..	5,406·25	4,760·45	63 4·38	17,137·62	
Mt. Ida ... ..	1,755·50	895·40	36 8·56	3,223·44	
Norseman ... ..	2,997·25	1,730·10	41 6·76	6,228·36	
Ora Banda ... ..	7,823·75	6,675·80	61 5·22	24,032·88	
Payne's Find ... ..	1,830·25	1,430·55	56 3·40	5,149·98	
Peak Hill ... ..	6,271·50	1,734·30	19 10·94	6,243·48	
Sandstone ... ..	4,562·75	2,923·15	46 1·49	10,523·34	
St. Ives ... ..	2,827·75	801·05	20 4·73	2,883·78	
Warriedar ... ..	2,232·00	867·65	27 11·91	3,123·54	
Wiluna ... ..	2,574·75	1,013·95	28 4·21	3,650·22	
Yarri ... ..	1,608·75	1,196·80	53 6·78	4,308·48	
Youanmi ... ..	227·00	33·45	10 7·32	120·42	
Yalgoo ... ..	2,222·75	1,060·25	34 4·08	3,816·90	
<b>Total ... ..</b>	<b>91,616·00</b>	<b>53,012·72</b>	<b>41 8·00</b>	<b>190,845·79</b>	

## SCHEDULE 2.

Tailings Treatment for 1933.

Battery.	Tonnage.	Yield.		Value.	Premium.
		Fine ozs.	£		
Bamboo Creek ... ..	1,380	606·97	2,558·67	2,120·36	
Boogardie ... ..	5,356	1,155·46	5,416·25	3,462·97	
Coolgardie ... ..	13,434	1,737·74	7,452·03	5,904·54	
Cue ... ..	8,195	1,375·33	6,208·69	4,406·18	
Kalgoorlie ... ..	13,500	2,030·13	8,450·71	7,209·97	
Jimble Bar ... ..	2,990	911·30	3,283·74	2,924·69	
Laverton ... ..	2,200	370·53	1,573·79	1,236·34	
Meekatharra ... ..	3,520	812·85	3,568·61	2,588·29	
Norseman ... ..	3,320	485·54	2,080·57	1,628·64	
Ora Banda ... ..	7,725	1,991·74	8,739·04	6,704·39	
Peak Hill ... ..	5,985	455·80	1,936·51	1,558·72	
Sandstone ... ..	4,444	793·86	3,703·69	2,366·97	
St. Ives ... ..	3,772	548·55	2,384·27	1,779·82	
Warriedar ... ..	1,585	299·57	1,291·56	934·41	
Wiluna ... ..	2,405	782·59	3,325·56	2,831·19	
Yarri ... ..	2,970	247·31	1,110·82	843·37	
Yalgoo ... ..	1,370	165·14	701·34	603·84	
<b>Total ... ..</b>	<b>84,151</b>	<b>14,770·41</b>	<b>63,785·85</b>	<b>49,104·69</b>	
<b>£112,890·54</b>					

## SCHEDULE 3.

Return showing Number of Parcels treated and Tons crushed at State Batteries for Year 1933.

No. of Parcels Crushed.	Battery.	Tons Crushed.	Yield by Amalgamation, Bullion.		Yield by Amalgamation, Fine Gold.		Gross Contents of Tailing (in- cluding refractory tails), Fine Gold.	Total Contents of Ore, Fine Gold.	Average per ton, Fine Gold.	Gross Value per ton.
			ozs. dwt. grs.	ozs. dwts. grs.	ozs. dwt.	ozs. dwt.				
25	Bamboo Creek ...	1,328	1,914 3 0	1,622 11 0	433 5	2,055 16	30 5	6 8 3		
156	Boogardie ...	5,363½	2,862 7 0	2,426 4 0	1,532 13	3,958 17	14 18	3 2 8		
357	Coolgardie ...	11,276½	7,657 7 0	6,490 16 0	1,866 0	8,356 16	14 19	3 2 10		
223	Cue ...	9,880½	4,914 8 0	4,165 14 0	2,163 3	6,328 17	12 19	2 14 4		
20	Jimble Bar ...	2,511	799 19 0	678 2 0	584 7	1,262 9	10 1	2 2 8		
394	Kalgoorlie ...	12,683½	5,318 16 0	4,508 10 0	2,237 6	6,745 16	10 16	2 5 4		
168	Laverton ...	4,773	2,473 5 0	2,096 10 0	886 5	2,982 15	12 12	2 13 1		
68	Marble Bar ...	1,843	1,949 11 0	1,652 10 0	539 0	2,191 10	23 16	5 0 7		
130	Meekatharra ...	5,426½	4,760 9 0	4,035 4 0	1,310 3	5,345 7	19 17	4 3 8		
28	Mt. Ida ...	1,755½	895 8 0	758 18 0	687 17	1,446 15	16 11	3 9 11		
120	Norseman ...	2,997½	1,730 2 0	1,466 10 0	801 14	2,068 4	13 19	2 18 7		
127	Ora Banda ...	7,854½	6,675 16 0	5,658 14 0	2,434 15	8,093 9	20 14	4 7 3		
43	Payne's Find ...	1,830½	1,430 11 0	1,212 12 0	200 10	1,413 2	15 10	3 5 5		
65	Peak Hill ...	6,185½	1,734 6 0	1,446 1 0	472 8	1,918 9	6 4	1 6 2		
45	St. Ives ...	2,827½	801 3 0	679 0 0	514 10	1,193 10	8 10	1 15 6		
118	Sandstone ...	4,562½	2,923 3 0	2,477 16 0	759 6	3,237 2	14 4	3 0 2		
56	Warriedar ...	2,182	867 13 0	735 8 0	660 2	1,395 10	12 18	2 14 2		
48	Wiluna ...	2,529½	1,013 19 0	859 8 0	690 8	1,549 16	12 6	2 12 0		
101	Yalgoo ...	2,282½	1,060 5 0	898 14 0	387 19	1,285 13	11 6	2 7 9		
37	Yarri ...	1,513½	1,196 16 0	1,038 0 0	203 16	1,241 16	16 9	3 9 6		
9	Youanmi ...	227	33 9 0	28 6 0	23 15	52 1	4 14	0 18 6		
...		91,834	53,012 14 0	44,935 8 0	19,189 2	64,124 10	13 23	2 19 2		

## SCHEDULE 4.

## Direct Purchase of Tailings.

Battery.	Tons purchased.	Amount.
		£ s. d.
Bamboo Creek ... ..	846	1,833 8 9
Boogardie ... ..	4,073 $\frac{1}{4}$	5,520 1 6
Coolgardie ... ..	6,126 $\frac{1}{2}$	5,241 10 10
Cue ... ..	5,543 $\frac{3}{4}$	5,879 2 10
Laverton ... ..	3,022	2,021 17 3
Jimble Bar ... ..	2,019 $\frac{3}{4}$	1,928 17 3
Kalgoorlie ... ..	5,880 $\frac{1}{2}$	5,923 3 9
Meekatharra ... ..	3,322 $\frac{3}{4}$	3,786 6 9
Norseman ... ..	1,937 $\frac{1}{2}$	1,897 2 5
Ora Banda ... ..	5,401 $\frac{1}{2}$	7,893 18 4
Payne's Find ... ..	839 $\frac{1}{2}$	118 16 10
Peak Hill ... ..	884	1,117 6 6
Sandstone ... ..	2,168	1,701 17 5
St. Ives ... ..	1,959	1,271 7 10
Warriedar ... ..	2,075 $\frac{3}{4}$	2,295 6 8
Wiluna ... ..	959 $\frac{3}{4}$	2,073 13 2
Yarri ... ..	773 $\frac{1}{2}$	727 0 3
Youanmi ... ..	165	24 18 7
Yalgoo ... ..	1,035 $\frac{1}{2}$	702 17 2
	49,033	51,958 14 1

## SCHEDULE 5.

## Return showing Tailing payable and unpayable and Gross Contents for Year 1933.

Battery.	Tailing payable.		Tailing unpayable.		Refractory tailing.		Totals.	
	Tons.	Gross Contents.	Tons.	Gross Contents.	Tons.	Gross Contents.	Tons.	Gross Contents.
		ozs. dwt. grs.		ozs. dwt. grs.		ozs. dwt. grs.		ozs. dwt. grs.
Bamboo Creek ... ..	1,133 $\frac{3}{4}$	431 13 0	16	1 12 0	...	...	1,149 $\frac{3}{4}$	433 5 0
Boogardie ... ..	3,731 $\frac{1}{2}$	1,459 16 0	896 $\frac{1}{2}$	72 17 0	...	...	4,628 $\frac{1}{2}$	1,532 13 0
Coolgardie ... ..	6,163	1,535 10 0	3,399 $\frac{1}{2}$	304 12 0	119 $\frac{1}{2}$	25 18 0	9,682 $\frac{1}{2}$	1,866 0 0
Cue ... ..	5,241 $\frac{1}{2}$	1,859 8 0	3,318	303 15 0	...	...	8,559 $\frac{1}{2}$	2,163 3 0
Jimble Bar ... ..	1,926 $\frac{1}{2}$	559 19 0	182 $\frac{1}{2}$	21 4 0	23	3 4 0	2,132	584 7 0
Kalgoorlie ... ..	6,281 $\frac{1}{2}$	1,827 6 0	4,621	400 3 0	42	9 17 0	10,944 $\frac{1}{2}$	2,237 0 0
Laverton ... ..	3,100 $\frac{1}{2}$	780 4 0	1,106	106 1 0	...	...	4,206 $\frac{1}{2}$	886 5 0
Marble Bar ... ..	...	...	...	...	1,580 $\frac{1}{2}$	539 0 0	1,580 $\frac{1}{2}$	539 0 0
Meekatharra ... ..	3,677 $\frac{1}{2}$	1,225 17 0	999 $\frac{1}{2}$	84 6 0	...	...	4,677 $\frac{1}{2}$	1,310 3 0
Mt. Ida ... ..	...	...	...	...	1,515 $\frac{1}{2}$	687 17 0	1,515 $\frac{1}{2}$	687 17 0
Norseman ... ..	2,098 $\frac{1}{2}$	565 10 0	496 $\frac{1}{2}$	36 4 0	...	...	2,595	601 14 0
Ora Banda ... ..	4,721 $\frac{1}{2}$	2,271 6 0	1,978 $\frac{1}{2}$	163 9 0	...	...	6,700 $\frac{1}{2}$	2,434 15 0
Payne's Find ... ..	1,003 $\frac{1}{2}$	153 8 0	584 $\frac{1}{2}$	47 2 0	...	...	1,588 $\frac{1}{2}$	200 10 0
Peak Hill ... ..	883 $\frac{1}{2}$	225 0 0	4,325 $\frac{1}{2}$	234 14 0	18 $\frac{1}{2}$	12 14 0	5,227 $\frac{1}{2}$	472 8 0
St. Ives ... ..	1,927	460 10 0	566 $\frac{1}{2}$	54 0 0	...	...	2,493 $\frac{1}{2}$	514 10 0
Sandstone ... ..	2,457	635 3 0	1,493 $\frac{1}{4}$	121 3 0	...	...	3,950 $\frac{1}{2}$	756 6 0
Warriedar ... ..	1,745	648 5 0	135 $\frac{1}{2}$	11 17 0	...	...	1,880 $\frac{1}{2}$	666 2 0
Wiluna ... ..	2,015	671 13 0	181	18 15 0	...	...	2,196	690 8 0
Yalgoo ... ..	1,052 $\frac{1}{2}$	270 11 0	799 $\frac{1}{2}$	68 18 0	101 $\frac{1}{2}$	48 10 0	1,953 $\frac{1}{2}$	387 19 0
Yarri ... ..	516	109 4 0	593 $\frac{1}{2}$	24 17 0	184 $\frac{1}{2}$	69 15 0	1,294 $\frac{1}{2}$	203 16 0
Youanmi ... ..	98 $\frac{1}{2}$	14 14 0	102 $\frac{1}{2}$	9 1 0	...	...	200 $\frac{1}{2}$	23 15 0
	49,774 $\frac{1}{2}$	15,704 17 0	25,796 $\frac{1}{2}$	2,084 10 0	3,585 $\frac{1}{2}$	1,396 15 0	79,156 $\frac{1}{2}$	19,186 2 0

SCHEDULE 6.  
Statement of Receipts and Expenditure for Year ended 31st December, 1933.  
MILLING AND TIN

Plant.	Tonnage.	Management.		Wages.		Stores.		Total Working Expenditure.		Cost per ton.	Repairs and Renewals.		Sundries.	Gross Expenditure.		Cost per ton.	Receipts.		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.		£ s. d.		
Bamboo Creek ...	1,328	127 19 7	554 15 8	293 17 0	976 12 3	14 8-4	119 5 0	123 10 11	1,219 8 2	18 4-1	637 5 1	9 7-1	...	...	582 3 1							
Boogardie ...	5,363-25	246 1 4	1,173 0 0	804 0 0	2,223 1 4	8 3-4	225 10 3	305 5 5	2,783 17 0	10 4-5	2,456 4 3	9 1-9	...	...	327 12 9							
Coolgardie ...	11,276-75	478 14 10	1,881 11 10	2,083 10 4	4,143 17 0	7 10-3	309 2 0	630 4 0	5,383 3 0	9 6-3	5,598 19 7	9 11-1	215 16 7	...	...							
Cue ...	9,778-50	289 9 10	1,135 0 0	1,549 2 4	2,993 12 2	6 1-5	284 2 4	472 2 0	3,749 16 6	7 8-1	4,846 18 2	9 6-9	1,097 1 8	...	...							
Darlot ...	...	...	...	...	...	...	...	...	...	...	57 6 3	...	...	...	...							
Jimble Bar ...	2,241	125 3 0	801 0 0	208 5 7	1,134 8 7	10 1-4	87 4 6	131 5 6	1,352 18 7	12 0 8	1,505 3 10	13 5-2	152 5 3	...	...							
Kalgoorlie ...	12,722-25	586 1 0	1,931 4 6	2,457 14 6	4,975 0 0	7 9-8	669 18 3	635 0 0	6,279 18 3	9 10-5	5,406 9 7	8 5-9	...	...	873 8 8							
Laverton ...	4,773	495 0 0	1,282 9 6	927 10 6	2,705 0 0	11 4-1	172 2 4	251 2 4	3,128 4 8	13 1-3	2,435 12 4	10 2-4	65 3 6	...	692 12 4							
Linden ...	...	...	...	...	...	...	...	...	...	...	65 3 6	...	...	...	...							
Marble Bar ...	1,793	266 2 6	737 1 6	508 2 6	1,511 6 6	17 4-9	109 3 6	142 4 10	1,762 14 10	19 7-9	1,051 1 9	11 8-7	...	...	711 13 1							
Meekatharra ...	5,406-25	268 2 0	1,411 3 8	1,353 3 4	3,032 9 0	11 3-0	406 3 9	319 3 3	3,757 16 0	13 1-3	2,618 3 10	9 8-2	...	...	1,139 12 2							
Mt. Ida ...	1,755-50	237 1 3	755 0 9	255 1 0	1,247 3 0	14 2-2	132 0 3	138 0 6	1,517 3 9	17 3-3	745 0 0	8 5-7	32 9 3	...	772 3 9							
Mt. Sir Samuel ...	...	...	...	...	...	...	...	...	...	...	32 9 3	...	...	...	...							
Mulline ...	...	...	...	...	...	...	...	...	...	...	23 13 9	...	...	...	...							
Norseman ...	2,997-25	271 0 3	1,046 2 6	619 1 9	1,936 4 6	12 11-3	336 0 0	205 0 9	2,477 5 3	16 6-7	1,777 0 6	11 10-3	...	...	700 4 9							
Ora Banda ...	7,823-75	302 1 6	1,953 5 3	962 1 9	3,217 8 6	8 3-1	242 2 1	549 3 6	4,008 14 1	10 3-1	3,283 18 2	8 4-7	...	...	724 15 11							
Payne's Find ...	1,830-25	156 2 4	611 3 8	418 5 2	1,185 11 2	12 11-7	154 1 10	129 2 4	1,468 15 4	16 0-6	943 1 3	10 3-6	...	...	525 14 1							
Peak Hill ...	6,271-50	250 4 11	1,352 8 4	826 2 6	2,428 15 9	7 0-3	368 1 8	351 1 2	3,147 18 7	10 0-7	2,392 11 4	9 2-6	...	...	755 7 3							
Pingin ...	...	...	...	...	...	...	...	...	...	...	10 0 0	...	...	10 0 0	...							
Sandstone ...	4,562-75	299 2 11	1,492 1 8	657 0 4	2,448 4 11	10 8-7	179 2 0	302 0 0	2,929 6 11	12 10-7	2,249 9 10	9 10-3	...	...	679 17 1							
St. Ives ...	2,827-75	200 4 5	926 2 7	657 1 6	1,783 8 6	12 7-3	162 0 6	204 1 11	2,149 10 11	15 2-4	1,442 14 9	10 2-4	...	...	706 16 2							
Tuckanarra ...	...	...	...	...	...	...	...	...	...	...	41 0 6	...	...	41 0 6	...							
Warriedar ...	2,232	163 19 6	623 2 6	321 4 3	1,108 6 3	9 11-6	259 0 9	159 1 6	1,526 8 6	13 7-5	1,089 6 2	9 9-1	...	...	437 2 4							
Wiluna ...	2,574-75	228 0 3	499 1 11	267 1 1	994 3 3	7 8-6	125 1 6	202 0 6	1,321 5 3	10 3-1	1,193 13 2	9 3-2	...	...	127 12 1							
Yarri ...	1,608-75	161 19 9	698 14 6	336 16 3	1,197 10 6	14 10-5	118 1 8	153 15 7	1,469 7 9	18 3-1	791 2 0	9 10-0	...	...	678 5 9							
Youanmi ...	227	43 6 8	79 3 4	37 2 8	159 12 8	14 0-8	9 1 6	10 2 6	178 16 8	15 9-0	73 7 7	6 5-5	...	...	105 9 1							
Yalgoo ...	2,222-75	157 3 7	517 1 4	321 1 8	995 6 7	8 11-4	208 2 8	118 1 4	1,321 10 7	11 10-6	1,097 10 10	9 10-4	...	...	223 19 9							
Tin Plant—Greenbushes ...	91,616	5,353 1 5	21,480 15 0	15,863 6 0	42,697 2 5	...	4,705 8 4	5,531 9 10	52,934 0 7	...	43,865 12 4	...	1,696 1 10	10,764 10 1								
...	...	...	...	...	...	...	...	...	26 1 2	...	2 0 0	...	...	24 1 2	...							
...	91,616	5,353 1 5	21,480 15 0	15,863 6 0	42,697 2 5	9 3-6	4,705 8 4	5,531 9 10	52,960 1 9	11 6-7	43,867 12 4	9 6-5	1,696 1 10	10,788 11 3	...							

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SCHEDULE 7.  
Statement of Receipts and Expenditure for Year ended 31st December, 1933.  
TAILING.

Plant.	Tonnage.	Management.		Wages.	Assays.	Stores.	Total Working Expenditure.		Cost per ton.	Repairs and Renewals.		Sundries.	Gross Expenditure.		Cost per ton.	Receipts.		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.		
Bamboo Creek ...	1,380	68 12 4	420 13 4	97 11 0	166 5 4	753 2 0	10 10-9	106 19 2	60 18 7	920 19 9	13 4-1	2,654 18 2	38 2-1	1,733 18 5	...	...					
Boogardie ...	5,356	107 10 5	834 19 3	85 14 11	464 2 6	1,492 7 1	5 6-8	9 4 3	178 9 3	1,680 0 7	0 3-2	4,126 13 8	15 4-9	2,446 13 1	...	...					
Coolgardie ...	13,454	198 13 9	2,242 3 9	142 2 0	868 5 7	3,451 5 1	5 1-6	...	403 12 6	3,854 17 7	5 8-8	8,222 17 1	12 2-9	4,367 19 6	...	...					
Cue ...	8,195	202 10 7	1,212 1 7	230 7 5	600 14 10	2,245 14 5	5 5-7	4 14 10	257 17 5	2,508 6 8	6 1-4	5,880 18 5	14 4-2	3,372 11 9	...	...					
Jimble Bar ...	2,990	162 8 1	591 2 2	66 19 7	486 1 11	1,306 11 9	8 8-8	13 3 6	53 3 7	1,372 18 10	9 2-2	4,084 17 0	30 7-9	2,711 18 2	...	...					
Laverton ...	2,200	121 11 9	367 18 10	96 10 8	197 3 4	783 4 7	7 1-4	12 13 4	74 9 4	870 7 3	7 10-9	1,452 13 6	13 2-4	582 6 3	...	...					
Meekatharra ...	3,520	101 16 4	604 8 11	58 2 10	215 9 8	979 17 9	5 6-7	13 10 4	121 10 1	1,114 18 2	6 4-0	3,788 11 7	21 6-3	2,673 13 5	...	...					
Mt. Ida ...	...	...	...	...	...	...	...	...	...	...	6 2 4	...	...	6 2 4	...	...					
Norseman ...	3,320	94 11 4	543 18 7	62 2 6	341 9 8	1,042 2 1	6 3-3	90 6 5	112 7 10	1,244 16 4	7 5-9	2,062 6 5	12 5-0	817 10 1	...	...					
Ora Banda ...	7,725	206 9 10	1,331 18 9	89 6 5	580 15 5	2,208 10 5	5 8-2	46 15 6	232 4 11	2,487 10 7	6 5-6	7,381 18 3	19 1-3	4,894 7 5	...	...					
Peak Hill ...	5,985	158 15 6	1,081 7 8	65 9 11	511 7 0	1,817 0 11	6 0-8	...	156 13 6	1,973 13 7	6 7-1	2,838 16 2	9 5-8	865 2 7	...	...					
Payne's Find ...	...	41 16 5	...	...	...	41 16 5	...	...	...	41 16 5	...	...	...	41 16 5	41 16 5	...	...				
Sandstone ...	4,444	139 1 8	780 7 6	164 5 7	423 0 2	1,506 14 11	6 9-3	1 12 0	136 18 9	1,645 5 8	7 4-8	3,990 2 10	17 11-2	2,344 17 2	...	...					
St. Ives ...	3,772	108 10 11	654 17 1	111 5 3	447 12 1	1,322 5 4	7 0-1	122 12 6	141 12 8	1,586 10 6	8 7-7	2,516 7 9	13 4-5	929 17 3	...	...					
Warriedar ...	1,585	28 0 0	198 15 0	116 5 6	104 13 2	447 13 8	5 7-7	21 5 0	56 13 1	525 11 9	6 7-6	490 12 0	6 2-2	...	34 19 7	...	...				
Wiluna ...	2,405	59 8 11	482 16 4	48 19 0	231 1 3	822 5 6	6 10-0	7 15 10	88 8 5	918 9 9	7 7-6	3,451 1 8	32 10-2	2,532 11 11	...	...					
Yalgoo ...	1,370	51 10 6	264 3 9	62 12 5	108 8 9	486 15 5	7 1-2	55 7 0	58 8 9	610 11 2	8 10-9	679 10 11	9 11-0	68 19 9	...	...					
Kalgoorlie ...	13,500	260 4 2	1,643 16 11	217 4 0	815 3 11	2,936 9 0	4 4-2	1 12 6	413 10 6	3,351 12 0	4 11-5	9,498 14 2	14 0-8	6,147 2 2	...	...					
Yarri ...	2,970	168 17 9	359 2 1	71 3 9	354 9 5	953 13 0	6 5-0	26 5 10	136 19 1	1,116 17 11	7 6-2	1,166 2 10	7 10-2	49 4 11	...	...					
Revenue Suspense Account	...	...	...	...	...	...	...	...	...	...	...	2,000 0 0	...	2,000 0 0	...	...					
...	84,151	2,280 10 3	13,614 11 6	1,786 2 9	6,916 4 0	24,597 8 6	5 10-1	533 18 0	2,683 18 3	27,825 4 9	6 7-3	66,293 4 9	15 9-7	38,544 16 2	76 16 2	...	...				

38069  
10788-11-3  
27679-8-9  
1436-1-10  
29375-10-7

76 16 2  
38069

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*Annual Progress Report of the Geological Survey of Western Australia  
for the year 1933.*

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## DIVISION IV.

# Annual Progress Report of the Geological Survey of Western Australia for the Year ended 31st December, 1933.

I have the honour to submit for the information of the Hon. the Minister for Mines my report on the work of the officers of the Geological Survey for the year 1933.

### STAFF.

The personnel of the Staff has remained unchanged from that of the previous year, and still remains at two field officers, one technical assistant and a messenger.

### FIELD WORK.

*Government Geologist.*—I was unable to be in the field as much as usual this year owing mainly to the absence of one of my assistants—Mr. Forman—for a period of six months, and my own absence for three months when doing special work for the Anglo-Australian Gold Development Company. Three short trips were made and reports furnished on the gold discovery at Wannaway and Yiniding Creek, and the Water Supply for the Margaret River Butter Factory.

The increasing number of inquiries also calls for more time in the office.

*F. R. Feldtmann, Field Geologist.*—With the exception of a short time in the field investigating the occurrence of glauconite sands at Gingin, a copy of which with maps is appended, practically the whole of the rest of the year was occupied on his report on Kalgoorlie.

*F. G. Forman, B.Sc., Assistant Geologist.*—In January, Mr. Forman completed his work on the correlation of the Artesian bores of the Metropolitan area. This was published in last year's Annual Progress Report.

During February, he assisted Miss Armstrong in the revision of the Catalogue of Scientific Periodicals, as it affected the Departmental Library. From March to September Mr. Forman acted as Lecturer in Geology at the University of W.A. during the absence of Professor Clarke. From September to the end of November he was engaged in an examination of the Ingliston Consols Extended, the Ingliston Alberts, and the Lady Central Gold Mines at Meekatharra. During December he investigated and reported on the prospects of boring for deep leads on the Greenbushes Tinfield.

### HEAD OFFICE.

*F. Armstrong, B.Sc., Technical Assistant.*—Throughout the year there has been an increased demand by the public for published information on potential gold-bearing areas of the State. To cope with these inquiries, Miss Armstrong has completed an Index map for the Annual Reports, which shows at a glance each area dealt with by articles published in the Annual Progress Reports of the Geological Survey of W.A. from 1897 to date.

This map in conjunction with a similar one for the bulletins gives the public ready access to published reports.

In addition, she has compiled a new geological map of the State. The 1920 map was used as a basis for the geology, and all work done subsequent to that date was added. In some places it was found necessary to alter the pre-existing boundaries as recent work had proved them at fault. The map is now in the hands of the Printer for publication.

Miss Armstrong was responsible for the selection of an exhibit of gold and minerals of economic importance displayed at the "Industries Exhibition" held in Government House Ballroom; and assisted me in the preparation and setting out of a gold exhibit at the Royal Show.

During the re-arrangement of the Library it was found that many publications contained therein had not been listed in the C.S.I.R. Catalogue of Scientific Periodicals. As entries for the Supplement to the Catalogue were being called for, Miss Armstrong compiled the cards for amended and new entries.

Owing to the demand for Bulletin 61: "An Outline of the Physiographical Geology (Physiography) of Western Australia," by J. T. Jutson (1913)—now out of print—the author was approached to re-write this work for a new edition. Due to the lapse of time since Mr. Jutson handed in his revised manuscript, many changes have been made in the geological boundaries of the State, which necessarily added largely to the amount of work attached to re-editing. Miss Armstrong has been in charge of this work, and was able personally to finalise with Mr. Jutson any alterations and additions when she was passing through Melbourne on her return from her annual leave.

In addition to the general routine work of the office, Miss Armstrong has dealt with the correspondence, made petrological determinations for the general public, and kept up to date the cross referencing of all articles on Australian geology published in scientific journals.

### PETROLOGICAL WORK.

The petrological work in determining rocks for both office and the public was carried out by Mr. Forman and Miss Armstrong, depending on the class of work.

The reports or summaries of the reports arising from the field work are attached, except in such instances when they were made for purely departmental use.

In conclusion, I take this opportunity for expressing my appreciation of the work and loyal support of the members of the Staff during the year.

T. BLATCHFORD,  
Government Geologist.

## 1.—THE GLAUCONITE DEPOSITS AT GINGIN, SOUTH-WEST DIVISION.

(F. R. Feldtmann.)

*Introduction.*—The chalky limestones at Gingin, in particular those capping One Tree and Molecap hills, were worked many years ago as a source of industrial lime. At a later date some attempt was made to utilise for agricultural purposes the phosphatic nodules which occur at several horizons in the Cretaceous rocks, but are particularly numerous in a zone occurring partly in the lower portion of the chalk, partly in the underlying greensand. A fair amount of the phosphatic material was quarried on the north-eastern slope of Molecap, but the deposit proved to be too narrow to be worked profitably. Recently, attention was drawn to the greensand beds as a source of the mineral glauconite ( $\text{KMgFe}_2(\text{SiO}_3)_6 \cdot 3\text{H}_2\text{O}$ ), which is an important constituent of the greensand and which has been found to be an effective water softener.

The Gingin area was visited by earlier observers such as Gregory, Brown, and Göczel, but although it has been of considerable interest to geologists, not only on account of the economic possibilities of the rocks, but also because of the abundant fossil remains found in the chalk, but little detailed geological mapping has been attempted. In 1909 and 1910 the area was examined by Mr. L. Glauert in connection with the limestone deposits, and a brief description of the geological features was given by him in the Annual Report of the Survey for 1910 (pages 29 and 30), and also in Bulletin 36, the latter report being accompanied by a small map and section on a scale of a mile to the inch. At the time of Mr. Glauert's examination, the lower bed of glauconitic sandstone, usually known as the Lower Greensand, was not exposed in a sufficiently unweathered state, in the area examined by him, to be identified and separated from the underlying shales.

A brief description of the geology of the Gingin area, accompanied by a geological section, was given by Dr. E. S. Simpson in his description of the occurrence of the rare mineral gearksutite on Loc. 457, about  $1\frac{3}{4}$  miles east of Gingin. (Mineralogical Magazine, May 1920, Vol. XIX, No. 89, pages 23-39.) The existence of the lower greensand was recognised by Simpson, who assigned to it a thickness of 100 feet.

The district was visited in 1930 by my colleague, Mr. F. G. Forman, in connection with an investigation by officers of the Department of Agriculture of the affection of stock by a disease known as "Gingin Ricketts." Mr. Forman's description of the geology of the district on pages 8 and 9 of the Annual Progress Report of the Survey for 1930 covers a somewhat wider area than that described by Mr. Glauert.

*Location and Topography.*—The small farming town of Gingin is situated on the Midland Railway Company's line to Geraldton, about 50 miles by rail, north of Perth. It lies on both sides of Gingin Brook which, north-east of the town, flows in a south-south-westerly direction but makes an abrupt U-shaped bend to the east where it is joined by Moonda Brook before flowing in a west-south-westerly direction through and west of the town.

The country around Gingin is strongly undulating, particularly north and south-east of the town. Several hills rise to a fair height above the level of Gingin Brook which, immediately west of the town, is about 270 feet above sea-level. The most prominent hills near the town are Moorgup, about  $1\frac{1}{2}$  miles south-east of the railway station, and about 667 feet above sea-level; Molecap, rather more than half a mile south-east of the station and about 510 feet above sea-level; One Tree Hill,  $1\frac{1}{4}$  miles north-north-west of the station and about 515 feet above sea-level; and Ginginup,  $2\frac{1}{4}$  miles north of the station, and about 666 feet above sea-level. The positions of the first three hills are shown on the accompanying map. The highest hill in the neighbourhood of Gingin is Poison Hill or Udoinup, about four miles north-north-west of the railway station, and 724 feet above sea-level. This hill has a steep escarpment facing north and north-west.

*Geology.*—Gingin lies in an area of Cretaceous rocks, the boundaries of which have not been determined. Cretaceous rocks including both chalk and ferruginous sandstone (weathered greensand) and containing bands with phosphatic nodules are known to occur at Dandaraga and Yatheroo, about 54 and 42 miles, respectively, north-north-west of Gingin. They have been traced from about eleven miles north of Dandaraga to about two miles south of Yatheroo, but whether the Dandaraga and Gingin rocks form parts of a continuous area is uncertain. In view of the economic possibilities of the Cretaceous rocks, a geological survey to determine their boundaries is desirable. On the west they appear to be bounded, in part at any rate, by the Darling Range scarp, which strikes about north-north-west and is considered, on topographical and other evidence, to be a fault scarp. In the Gingin area, the western boundary probably lies a short distance west of Poison Hill and One Tree Hill. East of Gingin the Cretaceous rocks probably extend to within a short distance of Mooliabeenie, where, I was informed orally by Dr. Simpson, small outliers of probably Cretaceous rocks overlie the granite. The positions of the northern and southern boundaries are quite unknown.

The general sequence of the Cretaceous rocks at Gingin, in descending order, appears to be:—

1. The Upper Greensand or glauconitic sandstone.
2. The chalk.
3. The Lower Greensand or glauconitic sandstone.
4. Shale and micaceous sandstone with little or no glauconite.

Accurate determination of the boundaries of the beds, their thickness, and the direction and degree of their dip is somewhat difficult, as over the greater part of the area they are obscured by soil, sand or ironstone gravel. In places their approximate position may be recognised by the character of the soil, the chalk, in particular, giving rise to a fine black soil easily distinguished from the red somewhat coarse and sandy soil derived from the greensand, but the shales are largely obscured by the accumulation of material derived in part from the overlying rocks.

The most satisfactory method of determining the boundaries, thickness and dip of the beds would be a contour survey, with the location of outcrops and quarry exposures, by means of the tachometer. A series of tachometer traverses in the vicinity of Gingin has been made by students of Geology of the University of Western Australia, and a copy of a contour map embodying the results of their work was obtained through the courtesy of the Department of Geology of the University. I am indebted to Professor E. de C. Clarke for permission to make use of the data afforded by this map, which has been of great assistance in fixing the approximate boundaries of the beds where no exposures were observed.

The profile shown on the geological section through One Tree Hill, Molecap, and Moorgup, is also based on the contours shown on this map. Additional work of this character is desirable.

The most convenient horizon for estimating the dip of the beds is the base of the chalk at its junction with the lower greensand. Good exposures of this junction are shown in the quarry on the north-eastern slope of Molecap and below the limekilns on the southern side of One Tree Hill. The mean of my observations at Molecap shows the base of the chalk to be 15.6 feet below the top of the hill, the height of which is shown on the University map to be 510.2 feet above sea-level. The base of the chalk at Molecap is, therefore, approximately 495.6 feet above sea-level. At One Tree Hill, the base of the chalk below the limekilns was roughly estimated at about 18 feet below the top of the hill which is shown as 515 feet above sea-level on the University map. Allowing for slight errors owing to the inadequate means for accurate survey at my disposal, these observations show the chalk to be practically horizontal between these two points, nearly  $1\frac{3}{4}$  miles apart. Of the other exposures of the chalk examined, one, a small outcrop, a few feet in length, on the south-western slope of Moorgup and usually known as "Compton's Chalk," is shown on the University map as 488 feet above sea-level; another, known as "Musk's Chalk," in a small open cut on Loc. 758 at a point  $1\frac{3}{4}$  miles east of the railway station, and 90 feet north of the road to Mooliabeenie, is shown at about 460 feet above sea-level. Compton's Chalk occupies its present position owing to a landslide that is known to have taken place in recent years, and the configuration of the ground near Musk's Chalk suggests that its present position may also be due to a somewhat older landslide. Practically all the other exposures known occur at or about the 500 feet horizon. On the accompanying map and section the base of the chalk is, except at the two last places mentioned, assumed to be approximately horizontal and 496 feet above sea-level.

The original thickness of the upper greensand is unknown. At Moorgup, where it is exposed on the top and on the south-western slope of the hill, the thickness is approximately 150 feet (*vide* the geological section). At Ginginup it is probably about the same. The rock composing this bed may not be of similar composition throughout. Simpson (*op cit.* p. 30) mentions that some bands are distinctly shaly, one such being seen about 20 feet above the gearksutite horizon on Loc. 457, but from the exposures observed it appears probable

that by far the greater proportion of the bed consists of glauconitic sandstone similar to that quarried in the lower greensand. Bands containing phosphatic nodules occur near the base of the upper greensand.

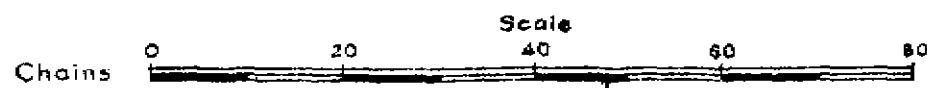
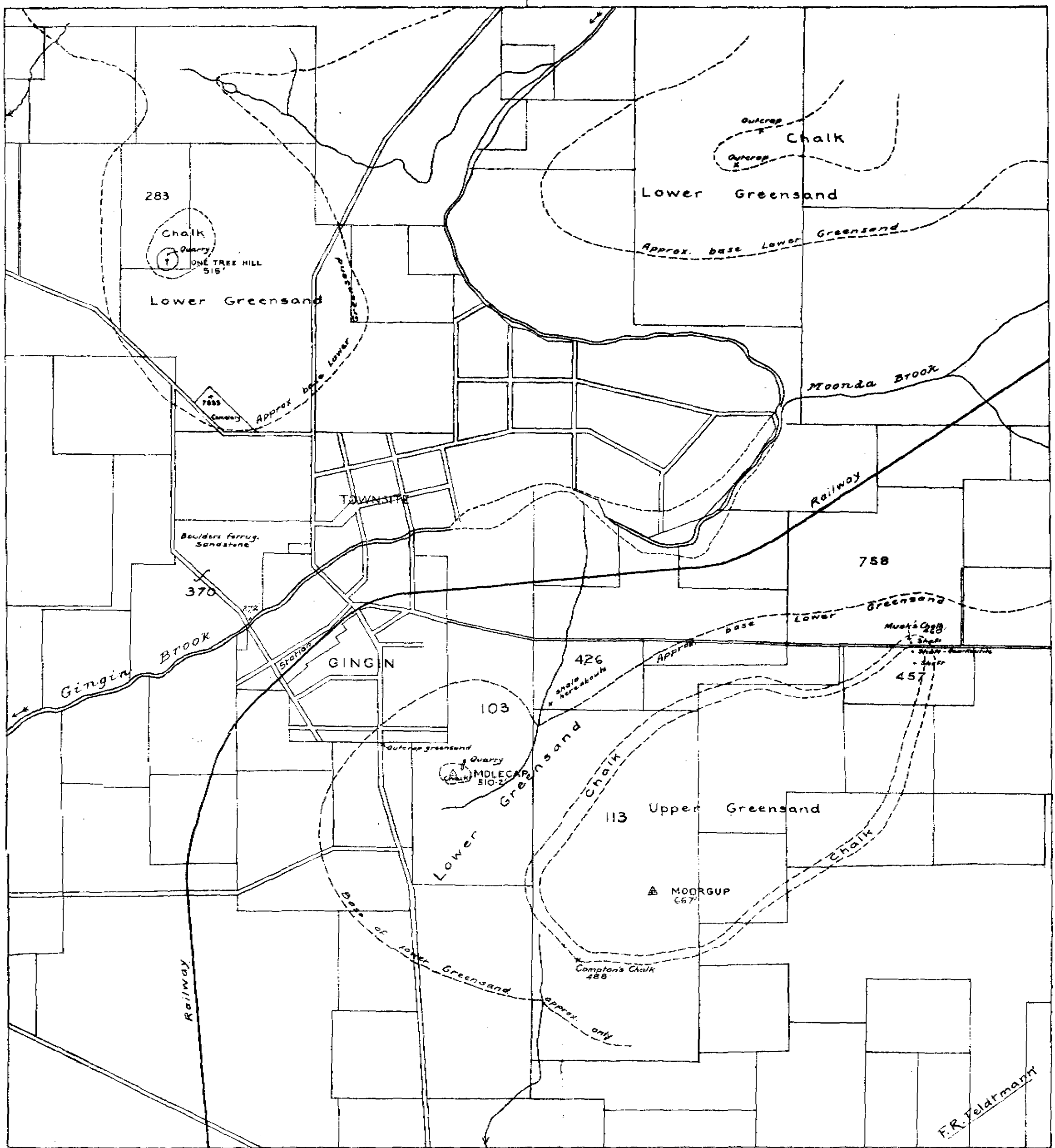
The thickness of the chalk can be estimated approximately although the exact figure is uncertain and the thickness may vary slightly from place to place. Simpson's estimate is 15 to 20 feet. At Molecap nearly 12 feet of chalk is exposed at the southern end of the quarry, the top of the chalk at this point being nearly three feet below the top of the hill. At One Tree Hill approximately 17 feet is exposed in the quarry and below the limekilns. On both hills the chalk is covered by black soil averaging about one foot in thickness, and resulting from the weathering of the chalk, so the original thickness was probably slightly greater. Near Compton's Chalk, exposures of both the upper and the lower greensand and above and below the chalk, respectively, indicate that its thickness at this point cannot be much more than 20 feet, which is assumed to be its thickness on the section.

The main portion of the lower greensand is separated from the chalk in the Molecap quarry by a band, between  $2\frac{1}{2}$  and 3 feet thick, of glauconitic sandstone containing numerous phosphatic nodules and a small proportion of chalk. The main bed of glauconitic sandstone is exposed in the quarry to a depth of 12 feet below the phosphatic band. Only about 3 feet of the rock underlying the chalk is exposed below the limekilns at One Tree Hill, and this is very similar in appearance to the phosphatic band at Molecap, consisting of somewhat weathered glauconitic sandstone with small fragments of chalk. It is, without doubt, underlain by glauconitic sandstone similar to that in the Molecap quarry.

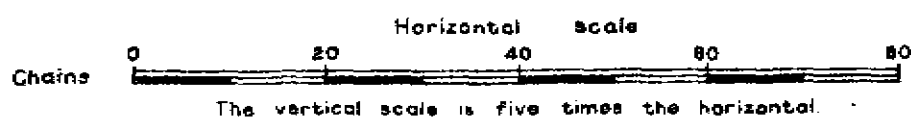
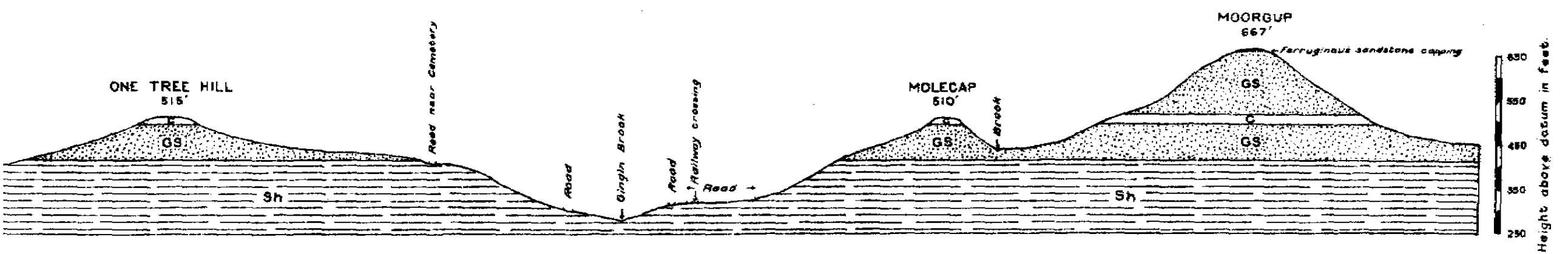
Owing to the lack of exposures in the area examined the exact thickness of the lower greensand could not be determined. Simpson (*op. cit.* p. 26) estimates it at 100 feet, but it is probably not so great as this. On the main road running south from the town, a definite outcrop of the greensand is exposed above, and in a gutter on the east side of the road at a point about 170 feet south of the short cross road running east towards Molecap. This outcrop was estimated to be about 430 feet above sea-level, or 66 feet below the base of the chalk. A somewhat doubtful exposure, that might be either massive or detrital, was observed a few feet lower down in the gutter. North-east of Molecap, an outcrop of the underlying shale occurs on Loc. 426 at a point a few feet below the 400 feet contour as shown on the University map. The lower greensand, therefore, is at least 66 feet and not more than 100 feet in thickness. On the section it is assumed to be about 80 feet. The determination of the true thickness of the lower greensand is of importance, as it will be understood from examination of the geological section, that each additional foot in thickness means a proportionally greater increase in the quantity of glauconitic material.

Relatively, little is known of the beds underlying the lower greensand or the depth to which they extend. The few exposures known indicate them to be mainly shales and micaceous sandstones with little or no glauconite, but it is possible that there is some lateral variation in the beds and that bands

GEOLOGICAL SKETCH MAP OF GINGIN.



SECTION THROUGH ONE TREE HILL, MOLECAP, AND MOORGUP, GINGIN.



LEGEND



FR. Feldmann

of glauconitic sandstone may occur interbedded with the shales. Small boulders of somewhat laterised ferruginous sandstone derived by weathering from glauconitic sandstone were observed in the northern portion of Loc. 370, east of the road which runs north towards One Tree Hill, and about the 300 feet horizon, and compacted material also derived by weathering from glauconitic sandstone was observed in a gutter on the same road at a much lower point some 500 or 600 feet north-west of Gingin Brook. Whether these exposures are *in situ* or have travelled a considerable distance from their source could not be determined.

*Workings in the Glauconitic Sandstones.*—The only place where the glauconitic sandstone has been quarried is on Loc. 103 in the lower greensand on the north-eastern slope of Molecap, on the site originally quarried for limestone and phosphatic nodules. The extent of the quarry and its position relative to the former trigonometrical station (now dismantled) on Molecap is shown on the accompanying plan and section. The southern end of the original quarry in the chalk is approximately 125 feet east-north-east of the old trig. site, that of the deeper cut in the greensand about 20 feet farther north. At this last point the greensand has been quarried to a depth of nearly 15 feet below the base of the chalk. The deepest end of a small cut from 10 to 19 feet in width, near the northern end and in the western half of the quarry, extends to a depth of about 16 feet below the base of the chalk. The main cut in the greensand is about 86 feet in length, the width ranging from about 14 feet at the northern and shallower end to a maximum of 35 feet close to the southern end.

*Conclusions and Recommendations.*—The geological sketch map accompanying this report covers barely half the area of the Cretaceous rocks definitely known to occur near Gingin. The average height of the area to the north of that shown on the map is considerably greater than the average of the area shown and the proportion occupied by the upper greensand must therefore be much greater, as is indicated by Mr. Glauert's map (Bull. 36. fig. 4). Any estimate of the quantity of glauconitic material available is at present impossible, but the sketch map and section indicate that it must be very great indeed, running into millions of tons in the area shown. The actual quantity existing in the known areas of Cretaceous rocks is, without doubt, enormous.

The site chosen for working the deposit is favourably situated, being near a good road and less than a mile by road from the railway station.

The best method of testing the thickness and glauconitic content of the greensand beds would be to put down a vertical bore with a drill, such as the Calyx, that would give a suitable core, the core to be sent to the Geological Survey for determination of the rocks and the choice of representative samples for analysis. A bore put down from the top of Moorgup to a vertical depth of 400 feet would not only test the glauconitic content at different horizons of both the upper and lower greensands and the vertical extent of the latter, but would also show whether other bands of glauconitic material are interbedded with the underlying shales.

The desirability of a survey to determine, so far as possible, the boundaries of the Cretaceous rocks,

together with a more detailed examination of the Gingin area, has already been mentioned.

## 2.—INGLISTON CONSOLS EXTENDED AND FENIAN GOLD MINES, MEEKATHARRA.

(F. G. Forman, B.Sc.)

These two properties at present held and worked by the Ingliston Extended Gold Mining Syndicate are situated about one and a half miles south-east of Meekatharra township on the southern part of the main portion of Paddy's Flat.

A detailed description of the geology and ore deposits of Meekatharra is given by E. de C. Clarke in G.S.W.A., Bulletin 68. This includes a description of the Ingliston Consols Extended and Fenian workings (included with the Marmont as the "Consols Group") as far as they had been developed at the time of his survey in 1915. The present examination of the two mines was confined to the workings developed since that date, together with such re-examination of the old workings of these and other mines as was necessary to a clear understanding of the geological features at present exposed.

At the time of the survey in 1915, the deepest development in the Fenian workings was at the No. 9 level (850 feet) and in the Ingliston Consols Extended workings at the No. 6 level (746 feet). Since that date development on the Fenian has extended to the No. 11 level (1150 feet) and on the Ingliston Consols Extended to the No. 12 level (1365 feet). Of these later workings the Nos. 7 and 8 levels of the Ingliston Consols Extended were of necessity excluded from examination owing to inaccessibility of the drives and stopes.

Bulletin 68 contains a detailed description of the petrology of the rock types encountered in the district, and also of the distribution of the rocks as exposed in the mine workings.

During the present examination no fresh evidence was obtained which would serve to change the general ideas expressed in Bulletin 68. A detailed description of the rocks and of their mode of origin is therefore considered unnecessary in this report.

The writer wishes to acknowledge his indebtedness for information set out in Bulletin 68 and to the staff and employees of the Ingliston Consols Extended Gold Mining Syndicate, all with whom he came in contact supplying much valuable information which would otherwise have been extremely difficult to obtain.

### *General Geology.*

The oldest rocks in the vicinity of the workings are a complex of greenstones of Pre Cambrian age, which may be subdivided into a number of distinct types, some of which have a doleritic and others a peridotitic origin.

### *Rocks of Doleritic Origin.*

These are represented chiefly by the "flecked schists" which are green or grey-green highly sheared rocks containing duller chloritic patches which give the rocks a flecked appearance. The flecked schists are the chief wall rocks of the lode above the Fenian No. 4 level (326 feet) and the Ingliston Consols No. 5 level (621 feet).

Chloritic slates, which enter the Ingliston Consols Extended shaft below the No. 8 level plat, and are found as a narrow band in the flecked schists at the lower levels, are probably also of doleritic origin, being presumably highly altered derivatives of the original dolerite in a zone of more intense shearing. They are grey-green imperfectly fissile rocks with a blocky fracture.

Fuchsite-quartz carbonate rocks, little sheared, and usually having a bright green colour due to the presence of the green chromium bearing mica, fuchsite, are also thought to have a doleritic origin. These rocks are usually found in close association with the porphyry dyke of the lode channel and are important because of their possible influence on the ore body in certain sections of the mines. See below.

#### *Rocks of Peridotitic Origin.*

These rocks are represented by a little sheared black carbonate rock which encloses the ore body below the Fenian No. 4 level (326 feet) and the Ingliston Consols Extended No. 5 level (625 feet). The rocks vary in appearance from place to place, the more highly sheared varieties being in some cases difficult to distinguish from the flecked schists.

#### *Porphyry.*

This is an albite quartz porphyry which varies in appearance from an extremely fine grained translucent white rock difficult in the hand specimen to distinguish from a bucky quartz or quartzite to a greenish or brownish green rock with distinct porphyritic texture. It is economically the most important rock in the mines because of its intimate association with the ore deposits.

#### *The Main Lode Channel.*

The main lode channel is a shear zone in the old greenstone complex, striking N.N.E., and dipping east. In the upper part of the workings the average dip of the lode is about 68°, but in the lower workings the lode steepens considerably; between the No. 10 and No. 12 levels of the Ingliston Consols the average dip being 80°.

This shear zone has been the path followed by a porphyry dyke (Paddy's Flat Dyke of Bulletin 68) and subsequently also by the ore bearing solutions.

#### *The Porphyry Dyke.*

The dyke does not everywhere reach the surface. In the northern part of the Ingliston Consols Extended Lease and in the southern part of the Marmont Lease, which adjoins the Fenian Lease on the south, the porphyry is present as a continuous dyke from 15 to 60 feet wide. In the upper levels of the main workings of the Ingliston Consols Extended and Fenian mines, the porphyry is present only in disconnected peaks which, however, join together below the No. 6 level of the Ingliston Consols Extended to form a continuous body lying in and more or less filling the shear zone. The dyke has an average width of 40-50 feet at the Ingliston Consols Extended No. 12 level (1,365 feet).

#### *Brecciation of Porphyry and Formation of Cross Fissures.*

Subsequent to the injection and cooling of the porphyry renewed earth movement caused the development of cross fissures in the porphyry with,

in places, a complete brecciation of the rock. Movement on several of the larger cross fissures caused actual sideways displacement of the dyke. Viewed in the mine workings this displacement has been almost invariably towards the west when looking north, the strike of the fissures being towards the south-east and the dip north. However, large displacements of the dyke seen in the northern ends of the drives at the Nos. 10 and 11 levels of the Ingliston Consols Extended are exceptions, the movement in these cases being towards the east looking north, the dip of the planes along which the movement took place being towards the south.

#### *The Ore Deposits.*

*Main Lode.*—The gold bearing solutions which were responsible for the formation of the ore deposits presumably travelled up along the same path as the porphyry dyke, and after its brecciation and displacement by the cross fissures or faults. The main lode in the upper levels consists of a network of gold bearing quartz veins and veinlets in a matrix of sheared rock, impregnated with arsenopyrite. In the lower levels where the porphyry is present as a continuous dyke more or less filling the shear zone, the lode is found either on the hanging wall or on the footwall of the dyke, while the fissures formed by the brecciation and cross faulting of the dyke are filled with veins of auriferous quartz. The lode must, therefore, be considered as including not only the sheared rock of the main shear zone, but the brecciated and fissured porphyry of the dyke. This is recognised by the mine management; the porphyry and the wall rock where it is found to carry values all being crushed in the mill.

*Spur Veins.*—Spur veins, which are auriferous quartz veins occupying cross fissures in the porphyry, are of frequent occurrence throughout the mines, but do not usually extend far into the country rock. Where they do extend into the country it is usually in the hanging wall or east side of the porphyry. These spur veins are usually richer than the main lode, indeed, it is said that were it not for the presence of these cross veins or spurs in the lower levels, the lode could not be worked at a profit. The strongest and most important of these spurs is the Fenian South-east spur, which has in the past contributed considerably to the total tonnage obtained from that mine. The cross fault on which this spur lies has displaced the porphyry from 40 to 45 feet in the Fenian workings, and the quartz vein carrying the gold averages 60 to 70 feet in length. The downward continuation of this spur, which dips to the north, is now being worked in the Ingliston Consols Extended mine at the Nos. 11 and 12 levels, but here the spur appears to be neither so strong nor so extensive as in the upper levels of the Fenian. Clarke, in Bulletin 68 (page 159), notes the poorness of the main ore channel south of the Fenian South-east spur for which he suggests that diversion of the ascending solutions by this and the Marmont No. 2 spur is responsible. This, combined with the influence of the country rock in the southern part of the channel (see next section), is in the opinion of the present writer responsible for the poorness of that part of the ore body south of the main south-east spur in the Ingliston Consols Extended. (Fenian S.E. Spur of Bulletin 68.)

*Influence of Country Rock on Productiveness of the Ore Body.*

In Bulletin 68 (page 90) the statement is made: "The ore bodies of the Paddy's Flat Belt are most productive where they lie in the 'flecked schists' (sheared dolerites), are less productive when in the 'black schists' (sheared peridotitic rocks), and are patchy in the fuchsite rock."

The present writer agrees with this statement and suggests that the varying tenor of the ore in the three rock types is due to the relative ease with which the solutions, which introduced the gold, were able to circulate. The flecked schists are more highly sheared than the others, and would be, therefore, presumably more porous. On the other hand the fuchsite rocks are very little sheared and are frozen or dovetailed on to the porphyry with which they are usually in contact, so that there was relatively little opportunity for the circulation of solutions. The rich patches which do occur in the fuchsite rocks are associated with local areas of more intense shearing or with strong cross faults of which the Marmont No. 2 spur is an example.

*Mine Development since Previous Survey.*

In the main section of the workings the chief development has been at the Nos. 10 and 11 levels from the Fenian Shaft, and at the Nos. 7 to 12 levels from the Ingliston Consols Extended shaft. In addition to this there are shallow workings in the northern part of the Ingliston Consols Extended lease from two shafts, the "Whip Shaft" (vertical depth 170 feet) with levels at 120 feet and 170 feet below the surface; and the "New Shaft." The latter shaft was not examined as all the necessary information was available from an examination of the "Whip Shaft" workings. A shaft near the south boundary of the Ingliston United lease, now known as Candy's Shaft, and identical with shaft D on sheet 7, plate XIII. of Bulletin 68, has been sunk to a vertical depth of 214 feet, the last 30 feet with an easterly underlay, with levels at 52 feet, 116 feet, 154 feet, 183 feet, and 214 feet, below the brace.

*Shallow Workings.*

In the shallow northern workings stoping has been confined to the richer cross leaders in the porphyry which here averages 50 feet in width. No stoping has been done in the main north-south drive at the 120 feet and 170 feet levels of the Whip Shaft which follow the hanging wall or east side of the porphyry. Because of the entire absence of assay plans of these and other parts of the mine it is impossible to gauge accurately the value of the lode material.

*Main Workings.*

The relationship of the mine openings to the geological features of the lode is shown clearly on the accompanying plans\* and will therefore not be described in detail.

It was originally planned to show by a distinctive marking the position of the lode in relation to the drives at the various levels, but when it was found that the profitable ore included not only the hanging wall and footwall shoots, but the porphyry itself, it was considered that the distribution of the porphyry as shown on the plans was a sufficient

\* Plans not published.

ent indication of the lode. In the Fenian workings where it has been the practice to mine only the lode material on the walls of the porphyry and in the spur veins, the stopes do indicate the position of the richer shoots of ore. These ore shoots are indicated on the plans.

The main south-east spur vein last seen in the Fenian Mine at the No. 10 level (1,000 feet) has not cut out below that depth, but passes into the Ingliston Consols Extended Mine, between the No. 9 level (1,030 feet) and the No. 10 level (1,150 feet), and is now being worked at the Nos. 11 and 12 levels as a spur off the main south drives. Failure to cut the spur vein at the Ingliston Consols Extended No. 10 level is accounted for by the presence of a complicated system of faults which have displaced the lode channel and the porphyry. The probable positions of the displaced porphyry dyke and the spur vein are indicated approximately on the accompanying plan\* of the Fenian No. 11, and the Ingliston Consols Extended No. 10 levels.

The spur vein 80 feet north of the crosscut at the Ingliston Consols Extended No. 11 level, and a similar vein opposite the crosscut at the No. 12 level, are considered to be one and the same ore body. Stoping on this spur was started at both levels, but was discontinued when the values cut out. The patchy distribution of the values is characteristic of both the main lode and the spurs, and further exploratory work at least on this spur is advisable, either by continuing the stope above the No. 12 level and using the broken rock as filling elsewhere, if of unprofitable grade, or by winzing on the spur from the No. 11 level.

The entire absence of assay plans and sections makes the question of development both laterally and at depth a difficult one to decide.

An examination of the Fenian workings shows that in the lower levels at least a considerable amount of prospecting driving has been done on the main lode channel south of the Fenian south-east spur, but that no stoping of any importance has been carried out from these drives. This suggests that the ore body was here found to be unpayable owing probably to the diversion of the gold bearing solutions by the spur, and to the unfavourable nature of the fuchsite carbonate rock enclosing the southern part of the ore channel at the lower levels. Although it cannot be definitely stated that a payable ore body does not exist in the southern continuation of the ore channel, past experience in the Fenian mine, as set out above, suggests the advisability of looking elsewhere for development.

The workings at the 120 feet and 170 feet levels from the Whip Shaft show that the main lode channel continues north of the present workings from the Main Shaft, but the absence of stoping except on the richer cross veins in the porphyry suggests that the main lode is here of low grade. Bulking the low grade ore with the richer cross veins, as is done elsewhere in the mine, may make the lode payable below the present development in this northern section.

The irregularity in longitudinal section of the northern limits of the stoping at the various levels from the Ingliston Consols Extended shaft suggest:

that other causes than the falling off in gold values were responsible. This idea is confirmed by the present management who state that stoping limits were determined by the increase in size of the porphyry dyke which increased the cost of mining by the hand drilling methods earlier in use to such an extent as to make further development unprofitable. With the modern machine drills now in use development to the north would seem to have a reasonable chance of success.

The increasing width of the porphyry dyke with depth in the lower levels is accompanied by a falling off in the gold values. This may be due to the same amount of gold which filled the ore channel where the dyke was narrow being distributed over a much greater area where the dyke is wide; or to a less extensive fracturing of the porphyry owing to its greater width, and therefore greater resistance to pressure, reducing the available space for the deposition of gold from the solutions.

There is no available evidence to indicate the behaviour of the porphyry dyke at depth below the present bottom level, No. 12 (1,365 feet). Exploratory boring with a diamond drill below the No. 12 level would indicate the width of the dyke and the existence of the ore channel at lower levels. Such boring, however, should not be relied on to indicate the presence or absence of payable ore, because of the characteristically patchy nature of the lode and the chance of the bore holes penetrating poor zones.

*Possible Extension of Ingliston Extended East Lode.  
(Mud Lode.)*

Exploratory diamond drill boring eastward from the end of the long east crosscut at the No. 9 level from the Fenian shaft, has explored the country to the east of the Main Lode channel for a distance of approximately 1,000 feet. Records of this boring have been lost so that no definite information is available. However, it seems likely that had any lode material been cut in the bores, some knowledge of it would be in existence to-day, even if only in the form of rumours which are common with most matters geological at Meekatharra. The complete absence of legends about this boring seems to indicate that no lode channel was cut in the bores. The east lode, therefore, if it extends southwards at all, would seem not to reach as far as the southern part of the Consols Group. No evidence other than that set out on pages 149 and 164 of Bulletin 68 is available which would help to decide this question.

*Conclusions.*

From the present investigations the following conclusions have been reached:—

1. There is an intimate association of the lode channel and the Paddy's Flat porphyry dyke, such that the dyke and the ore body may be considered as one.

2. The dyke is deep seated in origin and there is no likelihood of its "cutting out" within the limits of economic mining.

3. Lateral development at the southern end of the ore channel is not likely to reveal payable gold values because,

- (a) its great width (90 feet in the east crosscut of the Fenian No. 9 level) has enabled the dyke to resist the forces which further north have caused a fracturing and brecciation of the rock. Consequently, there was relatively little chance for the circulation of gold bearing solutions within the dyke such as has occurred in the fractured and brecciated zones,
- (b) circulation of gold bearing solutions has been retarded in the southern part of the ore channel by the diversion along the Fenian South-east Spur,
- (c) the encasing rock of the ore channel in its southern extreme is mainly fuchsite quartz carbonate rock, little sheared, which because of its relative freedom from shearing and its close contact with the porphyry dyke has further retarded the circulation of gold bearing solutions.

4. Although the absence of assay plans and sections makes a definite decision impossible it seems likely that the values have not cut out at the northern ends of the Ingliston Consols Extended drives, but that further northerly development was prevented by the difficulty of mining the porphyry dyke by hand labour.

5. The Fenian South-east Spur passes into the Ingliston Consols Extended lease between the No. 9 and No. 10 levels. It is identical with the main spur at present being worked at the Ingliston Consols Extended No. 11 level and No. 12 level, and in a winze below the No. 12 level.

6. Failure to find the main spur at the Ingliston Consols Extended No. 10 level is due to the displacement of the lode by faulting. The probable position of the displaced lode is indicated on the accompanying plan.\*

7. The spur vein 80 feet north of the crosscut at the Ingliston Consols Extended No. 11 level, and a similar vein opposite the crosscut at the No. 12 level are probably one and the same ore body. If the present dips observed on this spur and the more southerly main spur are maintained, the two should cut at a depth of approximately 200 feet below the present No. 12 level. Enrichment at, and for some distance above and below their junction can be expected.

8. There is no evidence available by which to make a definite prediction of the width of the porphyry dyke below the No. 12 level. Such dykes are characteristically irregular in section and the present average width of 50 feet at the No. 12 level may represent only a bulge.

9. Exploratory diamond drilling eastwards from the east crosscut at the Fenian No. 9 level indicates that, if the Ingliston Extended east lode does extend southward of its present known limits (no further evidence than that set out on pages 149 and 164 of Bulletin 68 is available on this point), it does not reach as far as the east side of the Fenian lease.

\* Plan not published.



### Recommendations.

1. Lateral development northwards, particularly from the upper levels of the Ingliston Consols Extended mine, where the northern faces of the drives and stopes are said to have been in ore of fair grade.

2. Exploratory driving on the footwall side of the porphyry at the No. 10 level north of the crosscut. The geological plan shows that the footwall of the porphyry has not been cut anywhere in the north drive.

3. Southwards extension of the Ingliston Consols Extended No. 11 south drive to pass under the winze sunk from the Fenian No. 11 level in which good gold values are said to have been obtained.

4. Continuation of the drive on the hanging wall side of the porphyry south of the crosscut at the Ingliston Consols Extended No. 12 level.

5. Continuation of the north drive at the No. 12 level where values should at least equal those obtained in the north drive at the No. 11 level.

6. Exploratory boring with a diamond drill below the No. 12 level in order to determine the width of the dyke at greater depth.

7. Exploration by actual mining operations below the No. 12 level to determine the tenor of the lode at greater depth. Because of the characteristically patchy nature of the ore body, diamond drilling cannot be relied on to determine the presence or absence of gold values.

### 3.—LADY CENTRAL GOLD MINE, MEEKATHARRA.

(F. G. Forman, B.Sc.)

Whilst engaged in an examination of the Ingliston Consols Extended and Fenian Gold Mines, the writer was told of recent developments on the Lady Central Lease, where it was said that at the 210 feet level from the New Shaft—supposed to be on the Ingliston Extended East Lode—the drive, which was in a northerly direction from the shaft, had cut basaltic dolerite in the face. It was known previously that somewhere in this vicinity the East Lode was cut off by a later basaltic dolerite dyke. It seemed, therefore, that the New Shaft workings were on the southern side of the dolerite, and consequently that the east lode extended further south than was previously known. Definite evidence of the presence of the Ingliston Extended East Lode on the south side of the dolerite would open up the question of its possible extension as far south as the Ingliston Consols Extended leases.

#### New Shaft Workings.

The New Shaft is situated about sixty feet south of the southern end of the old Ingliston Extended open cut on the East Lode. Short northerly drives have been put out from the shaft at the 100 feet and 210 feet levels.

The No. 1 level (100 feet) extends for about 62 feet north of the shaft in brown weathered schist with flecks and patches of fuchsite. The quartz

leader in which the gold values occur, lies in and strikes parallel with the schist and has an average width of about two feet and dips east at about 80°.

The No. 2 level (210 feet) extends north of the shaft about 100 feet, the country rock being a weathered black schist similar in appearance to the wall rock of the East Lode in the adjoining Ingliston Alberts Lease. The gold values occur in a quartz leader averaging about 1ft. 6in. in width with a dip of 75° to 80° to the west. The strike of the leader is parallel to the enclosing schists. Near the face the black schist becomes much harder than elsewhere in the drive. It was the increased hardness and the fine grained black appearance of the rock which lead the leaseholder, Mr. B. Rinaldi, to believe that he had cut the basaltic dolerite dyke.

#### Conclusions.

The drive at the 210 feet level of the New Shaft is entirely in black schist, probably an altered peridotite. The hardness of the schist in the face of the drive is due simply to its being less weathered than the schist elsewhere in the drive, and will be found to be the normal condition of the rock at lower levels in the sulphide zone.

The position of the dolerite dyke is indicated on Sheet 5, Plate XIII. of Bulletin 68. The New Shaft is on the northern side of the dolerite and its position in relation thereto is shown on the accompanying plan.\*

There is some doubt as to whether the quartz leaders exposed at the No. 1 and No. 2 levels are one and the same because of the discordancy of their dips. The brown schist at the No. 1 level might quite easily be a more weathered form of the black schist at the No. 2 level, but the fuchsite flecks and patches seen in the schist at the No. 1 level are absent from the schist at the No. 2 level. If the dips observed in the schist at the No. 1 level are maintained in depth, similar country should be found to the east side of the No. 2 level drive. This should be tested and the extension of the No. 1 level leader looked for by an east crosscut at the No. 2 level.

#### Western Workings.

The workings in the western part of the Lady Central lease lie in, and along, the walls of the Paddy's Flat porphyry dyke which averages about 35 feet in thickness. Stopping has been confined to rich quartz cross leaders in the porphyry. The leaders, which apparently lie in pre-gold fault fissures, run at various angles across the porphyry. They are said usually to carry gold throughout their length, but enrichment is found to take place where two leaders intersect and cross, particularly if the intersection takes place in schisted country on either side of the porphyry. The accompanying plans\* show the relationship of the workings to the porphyry dyke, but the numerous auriferous cross leaders are not shown, as to do so would not serve any useful purpose and the work necessary to map them was, therefore, not justified. Several of the cross leaders, drives on which are already indicated on the mine plans, are shown and illustrate the mode of occurrence of the whole system.

\* Plan not published.

In an east crosscut near the southern end of the 160 feet level south drive, a small quartz leader is exposed which is said to have carried gold values where it was worked in the adjoining lease, the United. The leader as exposed in the crosscut, lies parallel to and about fifteen feet east of the hanging wall of the porphyry, but does not contain payable gold values. The values in such quartz veins and leaders in other parts of Paddy's Flat are characteristically patchy, and a northern drive on this leader, with the object of prospecting for other shoots of auriferous quartz, seems worth while.

#### 4.—INGLISTON ALBERTS G.M., MEEKATHARRA.

(F. G. Forman, B.Sc.)

The following brief description of the geological features of the East Lode in the Ingliston Alberts Lease (late Ingliston Extended\*) is written after an examination made at the request of the Syndicate.

The East Lode is a shear zone in the black schist (altered peridotites) lying parallel to and about 180 feet east of the Paddy's Flat porphyry dyke. Throughout its greater part the East Lode lies close to a fine grained basaltic dolerite dyke, which is of later date than the ore body. This dyke and the ore body are not strictly parallel, and the effect where the dyke approaches closer than usual to the shear zone of the lode, is a partial squeezing out of the lode with a consequent reduction of the normal stopping width. This is purely a mechanical effect, so that should it be found on further development that the dip of the dyke changes, and the lode is consequently entirely pinched out, it should be found again without any alteration in values on the other side of the dyke.

The present lowest level on the East Lode is at 550 feet, and is driven north from the Faithful Shaft for a length of about 380 feet. All payable ore vertically above this level has been stoped out by the Ingliston Extended Company. The present holders, the Ingliston Alberts Syndicate, have sunk two winzes each 50 feet deep below the 550 feet level. These winzes, the No. 1 winze and the No. 2 winze, are 40 feet and 145 feet respectively north of the crosscut from the Faithful Shaft.

The lode at the bottom of the No. 1 winze is exposed over a width of 10 feet. The footwall or west side of the winze at the bottom appears to coincide with the footwall of the lode, but a definite hanging wall on the east side of the winze has not yet been exposed.

At the bottom of No. 2 winze the lode is exposed over a width of 16 feet. The western side or footwall of the winze appears to coincide with the footwall of the lode, but bore holes put out into the hanging wall still show gold values continuing.

It is stated by the Manager that the average value of the ore exposed in No. 1 winze and No. 2 winze is about 15dwts. of gold per ton. The basaltic dolerite dyke which lies close to the hanging wall of the lode at the upper levels, has not yet been exposed in either of the winzes.

\* A full description of the geology and ore deposits of the Ingliston Extended mine is contained in G.S.W.A. Bull. 68.

#### Conclusions.

The East Lode is of deep seated origin and the gold values are likely to continue to much greater depths than the present deepest workings.

The widening of the lode in the two winzes below the 550 feet level is probably due to the greater distance between it and the basaltic dolerite dyke which appears to have flattened its dip and has, therefore, retreated eastward away from the lode channel.

The present width of the lode is likely to be maintained in depth, unless a further change in the dip of the dolerite dyke causes it to again enter the lode channel.

Should the lode at greater depth be completely pinched out by the dolerite dyke, it should be found again without any alteration in gold values on the other side of the dyke, the barren interval depending on the width and dip of the dyke.

#### *Ingliston Alberts (Ingliston Extended) Main Spur.*

The main spur is a body of quartz almost vertical and striking parallel to and about 70 feet east of the west lode which lies on the hanging wall side of the Paddy's Flat porphyry dyke. The Main Spur has been faulted between the No. 1 and No. 2 levels. The effect of this faulting is shown diagrammatically in the plans or plate XV. and the section on plate XIX. of Bulletin 68.

It was suggested to the writer by the Underground Manager, that instead of the faulting being on one plane as depicted in Bulletin 68, it might be on two parallel planes and that in consequence a further body of ore might exist between these two planes somewhere between the No. 1 and No. 2 levels.

After inspection of the fault planes exposed at both levels, and a study of the plans and sections in Bulletin 68, the writer is of the opinion that the conditions as depicted by the plans and sections in Bulletin 68 actually do exist, and that therefore no isolated body of ore representing a displaced portion of the Main Spur will be found between the two levels.

#### 5.—SUGGESTED BORING FOR "DEEP LEADS," GREENBUSHES TINFIELD.

(F. G. Forman, B.Sc.)

The first locality examined was an extensive sandy flat at the head of Moulton Brook (locally known as Battler's Gully). On the old Battler's Hope leases, M.L's. 313-314, two deep shafts have been sunk, with the object of prospecting for a "deep lead." These shafts are now inaccessible, but the following extract from Bulletin 32 describes the conditions as found and coincides with descriptions supplied to me by miners with local knowledge.

Battler's Hope, M.L. 313-314.\* These old leases are situated at the head of Moulton's Brook, more generally known as Battler's Gully, and upon these, close to their dividing boundary, two deep shafts have been sunk, with the object of prospecting for a "deep lead."

The southern of these two was sunk to a depth of 126 feet, cutting the wash at 96 feet 3 inches, where it was about 15 inches in thickness and composed of numerous large well water worn boulders of quartz, quartzite, greisen and mica schist, with softer much decomposed rounded boulders of clayey ironstained rock, the whole being intermixed with ferruginous earth and sand.

At a depth of 106 feet below the wash a level was driven south-west in decomposed mica schist for a distance of 120 feet, which rose into it at a distance of 50 feet from the shaft. Another drive was also carried 40 feet north, when work had to be abandoned owing to the collapse of the shaft bottom.

Another shaft was sunk a little farther north to a depth of 103 feet, bottoming upon a hard diorite bar, which was driven in 6 feet. The wash in this shaft was cut at a depth of 93 feet, whilst a level drive 60 feet south from the shaft rose into it at a distance of 30 feet.

† From the appearance of the larger boulders at surface it is evident that a true "wash" or river-worn bouldery gravel was encountered, pointing to the existence in past times of running streams of considerable carrying power, and to different climatic conditions from those now prevailing.

A little tin ore was obtained by Mr. Johnston while working the "wash," but it was altogether too poor to be payable. The presence of the ore, nevertheless, gives ground for thinking that the "gutter" of the lead, when found, is likely to carry payable deposits. Above the "wash" there was in the shaft about four feet of dark clayey matter, covered by two feet six inches of fine drift, from which a good deal of water made into the shaft. On top of this drift there was a thin hard band or layer of oxide of iron cement, then 50 to 60 feet of brown mullocky material, with iron oxide concentrations and angular pieces of quartz. Mr. Johnston tells me that this has been repeatedly mistaken in the district for the true bedrock. Near surface the ground is hard white and brown cemented grit and sand. The succession of strata is as described by Mr. Johnston; the shaft being full of water I could not further verify them.

The "wash" and boulders at this shaft were very similar to those at the "Hard Graft" and adjacent shafts above mentioned, and I think there is much likelihood of their being all on the same deep lead.

This deep lead has evidently nothing to do with the present shape of the surface, its course being quite independent of the modern watercourses, and the latter are no guide as to where it might be expected to be met with. To the westward of the "Battler's Hope" it may be entirely removed by the modern erosion of the country, in which case some trace of it should be found where the old channel emerges on the more recent surface, or it may possibly continue as a buried lead, in that case probably going out somewhere towards the junction of Cowan's and Norilup Brooks. At Johnston's shaft the belt of deep ground is some 15 chains in width with shallow ground to north and south, and as the bedrock in the levels was dipping to the north-west it is evident that the shaft must be on the south side of the "gutter," though fairly well in the centre of the belt of deep ground. The next shaft should therefore be sunk further to the north.

From the above it will be seen that the evidence for the existence at this point of a "deep lead" at a depth of about 100 feet is fairly conclusive.

From the Battler's Hope leases a sandy flat extends north-westward to Paper Bark Swamp, where dredging for alluvial tin has been successfully carried on, the belt of stanniferous wash extending north-westwards to the exceptionally rich ground on the north side of Spring Gully. Paper Bark Swamp has been worked to a depth of about 12 feet, the bottom of the excavations being marked by a layer, a few inches thick, of well water-worn quartz and greisen boulders resting on a stiff brownish clay. Well holes, up to ten feet deep, in this clay "bottom" have not revealed any tin, but it is doubtful that the clay really represents the true "bottom" of the alluvial wash.

Extending south-eastwards from the Battler's Hope leases through claim 863 to the East Phoenix Lease, M.L. 571, there is a line of stanniferous wash at a depth of 28-30 feet, which has been profitably worked from numerous shafts. The tin bearing layer is a fine to medium grained well water-worn "wash" which is said to have yielded in places as much as 1/2wt. of cassiterite to the cubic yard. During the early stages of the development of this shallow lead, some trouble was experienced during the winter months through water rising in the workings. It was found that by putting down bore holes or wells into the clay "bottom," the water immediately drained to some lower porous stratum. This proves that the clay "bottom" beneath the stanniferous wash is not the true "bottom" of the alluvial material, and where deeper alluvium exists beneath a known stanniferous wash there is every chance of other payable "leads" existing at greater depth in the deposits. That such "leads," if they exist, are likely to be of high grade is suggested by the highly profitable nature of the shallow wash already worked.

On the East Phoenix, M.L. 571, and the ground adjacent thereto, known as the Three C's, extensive but shallow dredging operations have been carried out at a profit. An inspection of the excavations shows that what has been taken as "bottom" is not the true base of the alluvial material, and that other alluvial beds with possible stanniferous "leads" may exist at greater depth.

Referring to the locality of the Three C's Woodward says\*: "The head of this gully consists of a large water-logged sandy flat, called the Three C's after the original holders of the lease, Messrs. Cowan, Castella, and Clark. In this flat, tin in small quantities occurs in the sand from the surface downwards, it appears to be of lacustrine origin, having been deposited at a subsequent period to that at which the "deep lead" crossed this area as an open valley, and prior to the cutting out of the present deep channel of Cowan's Brook."

The next locality visited was the vicinity of the old Hard Graft Leases, where a deposit of deep alluvial ground (Elliot's "Lead") has been extensively worked, extending westwards from the old Bunbury Lease at the lower end of Bunbury Gully. At the time of my inspection all the workings on this run were inaccessible. The following extract from Mr. Montgomery's report† is of interest.

\* H. P. Woodward, Assistant Government Geologist, G.S.W.A., Bull. 32, page 66.

† A. Montgomery, M.A., F.G.S., State Mining Engineer, Dept. of Mines, W.A., Ann. Report, 1903.

\* Bulletin 32, page 65.

† Notes upon the Greenbushes Tinfields, A. Montgomery, M.A., F.G.S., State Mining Engineer. W.A. Dept. of Mines, Ann. Report, 1908.

The Bunbury Gully has been shallow ground all the way down, and has been pretty well worked out; but at the lower end there is a deposit of deep alluvial ground, through the Hard Graft and adjoining claims, which appears to belong to an entirely older set of alluvial deposits, and to be part of a "deep lead." In this the "wash" is composed of large well-rounded boulders, and the tin ore is much rounded and water-worn. Some of it is cemented with oxide of iron and requires crushing. I had no time to more than look over the dumps of a few of the claims in this part of the field, but the evidence of a "deep lead" was very obvious. It seemed to run across the course of the present valley, towards the Battler's Hope, and prospecting along this line seems very desirable.

On its south bank Elliot's "Lead" is very shallow, but attains a depth of sixty feet on the Hard Graft Lease. In other places the "lead" is much shallower, the average depth being about twenty feet. The deeper ground appears to represent holes beneath the general level of the "lead," and it is in these holes that the richer tin deposits seem to occur. This feature is said to have been noticeable also in other "leads" on the field.

At the western end of Elliot's "Lead" the stanniferous wash ended suddenly against a bank. This bank coincides with a low southerly pointing spur at the surface and probably represents a sudden bend in the old watercourse.

When this bank was struck, further prospecting on the south side led to the discovery of tin bearing wash at a shallow depth under an extensive sandy flat, known as Poverty Flat.

Poverty Flat has been the scene of profitable dredging operations, but the ground has only been worked to a shallow depth; the bottom of the excavation is obviously not on bedrock, and as the present "bottom" carried tin, if a deeper run exists it may prove to be very rich. The logical position in which to seek a continuation of Elliot's "Lead," which has contributed so richly in the past, is beneath Poverty Flat, where it would seem to have been diverted in a southerly direction after striking the bank mentioned above.

A very brief inspection was finally made of a "lead" running southwards from the old Glasgow Lease at the western end of the town across the main road, and in a southerly direction through the old Mt. Pleasant Lease to the head of Spring Gully.

Bedrock appears to have been reached on the Glasgow and the leases immediately adjoining, but an inspection of excavations on the leases to the south of the main road makes it appear doubtful if bedrock has been truly reached in this locality. A few judiciously located bores would serve to verify this point.

#### *Conclusions and Recommendations.*

The present investigation can in no way be considered complete for the Greenbushes Tinfield or even for the special localities examined. My inspection was confined wholly to a few of the places where mining operations suggested that undevel-

oped "deep leads" might exist, and the testing of which would involve the minimum of time and expense.

Mining operations have proved the existence of a "deep lead" in Elliot's Gully. This "lead" comes against a bank to the west of the Hard Graft Lease and then appears to turn sharply southwards beneath Poverty Flat. From this point it probably turns again and follows a north-westerly course beneath the Three C's and the East Phoenix Lease to the Battler's Hope Lease at the head of Moulton's Brook (Battler's Gully), at which point it has been picked up in the two deep shafts.

A second "deep lead" may exist, running from the rich ground on the north side of Spring Gully south-easterly through Paper Bark Swamp, and joining up with the first "lead" under the sandy flat in the vicinity of the Battler's Hope.

Below their junction the two "leads" probably run westward on the north side of Moulton Brook as shown on the map accompanying Bulletin 32.

The most certain and economical method of proving the existence of "deep leads" is by a series of hand bores put down to bedrock in a systematic manner.

The deep shaft on the Battler's Hope Lease would appear to be on the south side of and close to the "gutter" of a "deep lead." The position of this "gutter" should be fixed by a line of closely spaced bores in a northerly direction from the shaft; and, on the position of the "gutter" being defined, its length and possible value should be proved by other lines of bores put down across the supposed position of the "lead" at the surface.

Other lines of bores should be put down across the supposed position of the "deep lead" at Paper Bark Swamp, the East Phoenix Lease, and on Poverty Flat, with the object of prospecting the "deep lead" in these localities.

The fact that in all these localities tin has been recovered at a profit from the shallow ground suggests that the "deep lead," if it exists, should carry valuable tin deposits.

The location of the sites for the bore holes would of necessity have to be made on the ground, and it is essential, if boring is to be carried out, for a man with practical experience in sampling tin prospects to be present to collect samples for assay, and properly to record the results of the boring.

The greatest depth to which boring would be necessary would be little over one hundred feet, while the great majority of the holes would be much shallower, probably not more than 50-60 feet. The total number of holes to be put down can hardly be judged, but as the work proceeded and the shape and direction of the "lead" became known, fewer bores would be needed than in the earlier stages. The definition of the "gutter" of the "lead" in the four localities mentioned above would probably involve the sinking of from 20 to 30 holes, varying in depth from 60 to 100 feet.

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## DIVISION V.

### School of Mines of W.A.

Kalgoorlie, 7th December, 1933.

*The Under Secretary for Mines, Mines Department, Perth.*

I have the honour to submit, for the information of the Hon. Minister for Mines, my report for the year 1933.

#### ENROLMENTS.

The individual enrolment during the year numbered 306, the highest for a number of years, but, as usual, there was a considerable falling off towards the end of the year.

The class attendances have been satisfactory, and the work of the school has gone on without interruption during the year. The enrolments and attendances in many of the advanced course classes have been much greater than usual, partly owing to the fact that the reduction of staff which took place in 1931 rendered it imperative that the two grades of certain subjects should be given only in alternate years. In addition, for the same reason, the hours of instruction in certain classes have had to be reduced, which has resulted in the lecturers being able to deal only with the outlines of the subjects, and to direct the reading and outside study of the students. These two disadvantages can only be removed by an increase in the staff to six full-time officers, as was the case in 1930, as such an increase would relieve the senior lecturers of the necessity of conducting classwork in the elementary portions of their respective subjects, and would enable them to devote more time to the more specialised work of the advanced classes.

It is pleasing to note that the Hon. Minister has approved of the appointment of an Assistant Lecturer in Mathematics and Chemistry to take up duty in 1934. The appointment of this officer and the consequent slight re-arrangement of the duties of the other members of the staff will to some extent remove the disabilities which the staff and students have been experiencing during the last three years. Nevertheless, these disabilities can only be completely removed by the appointment of an additional assistant lecturer, which should be seriously considered if the enrolment and class attendances increase next year, because under the present arrangement some students are compelled to wait twelve months for certain of the alternating subjects which they require to complete Diploma or Certificate Courses.

A number of students who are holding positions on mines at Gwalia, Wiluna, and Laverton have been assisted in the continuance of their studies, and the necessary arrangements have been made for holding the examinations at those centres under the superintendence of responsible mine officials, to whom the appreciation and thanks of the school and the students are due for their gratuitous assistance in this direction.

#### REVENUE.

The total revenue for the school year has been approximately five hundred and thirty-three pounds, of

which one hundred and sixty pounds consists of fees received for the conduct of metallurgical investigations and special assays for Wiluna Gold Mines, Limited.

#### METALLURGICAL LABORATORY.

During the past year the number of investigations conducted by the metallurgical staff has increased to forty-six, almost entirely due to the re-opening of old mines and the activity in the treatment of old residue dumps all over the State. Cyanide operators and the executives of companies which are re-opening old mines are now recognising the necessity and the wisdom of having their treatment problems fully investigated by competent metallurgical experts before attempting to enter on the treatment of old residues or to design a mill for the treatment of current ore. In many cases the metallurgical staff have been able to suggest and give details of the treatment by cyanidation of old residues, previously considered impossible to treat, which have enabled the operators to secure highly payable extractions of gold, and in other cases have been able to show conclusively that the treatment of some residues would not be commercially profitable, thereby saving the owners the loss that would inevitably have been incurred if they had erected cyanide plants without having the treatment of their residues thoroughly investigated beforehand.

The following list shows the nature of the investigations carried out during the year and the persons and companies for whom these investigations have been conducted:—

- Treatment of Great Boulder ore by bromocyanidation for Great Boulder Proprietary Gold Mine.
- Cyanidation of tailings from Bulong for Mr. G. F. Mead.
- Cyanidation of tailings from the Potosi Gold Mine for Messrs. Paton and Thompson.
- Cyanidation of tailings from the Bellevue Gold Mine for Mr. C. de Bernales.
- Treatment of ore from the Two D's Gold Mine for Mr. J. Semmens Allen.
- Treatment of clean-up material from Kunaling for the Mines Department.
- Strakes concentration of tailings from the Burbanks Birthday Gift Gold Mine for Mr. H. A. Frank.
- Strakes concentration of wash from Paddington for the Mines Department.
- Cyanidation of tailings for Messrs. Collier and Balmer of Menzies.
- Amalgamation test on ore from McKenzie's Find for Mr. M. H. C. McKenzie.
- Cyanidation of tailings from Norseman for Mr. N. Grinsell.
- Retreatment of old residues for Great Boulder Proprietary Gold Mine.

Cyanidation of slimes from the Gimlet South Gold Mine for the Gold Recovery Syndicate.  
 Cyanidation of tailings from the Corinthian North Gold Mine for Mr. J. Bradley.  
 Cyanidation of tailings from the Croesus Oversight Gold Mine for Mr. L. T. Cotterell.  
 Cyanidation of sands and slimes for Mr. J. L. Cunneen.  
 Cyanidation of tailings from the Brownhill Consols Gold Mine for Mr. C. G. Elliott.  
 Cyanidation of slimes from the Leviathan battery for Mr. J. L. Cunneen.  
 Cyanidation of tailings from the Queensland Menzies Gold Mine for Messrs. Collier and Balmer.  
 Cyanidation of slimes from Raven's Dump, Kalgoolie, for Mr. J. Riley.  
 Cyanidation of tailings from the White Feather Main Reef for Mr. J. Stene.  
 Treatment of tailings from the Paris Mines for Mr. K. C. McSwain.  
 Cyanidation of tailings from the Menzies Consolidated Gold Mine for Mr. J. Semmens Allen.  
 Treatment of ore from the Ingliston Alberts Gold Mine for Mr. A. J. Gerick.  
 Cyanidation of tailings from the Break o' Day Gold Mine for the Mines Department.  
 Cyanidation of tailings from Northam for Nixon Brothers.  
 Cyanidation of slimes from Paddington for Mr. P. M. Crudace.  
 Treatment of ore from the Lancefield Gold Mine for Mr. G. Ridgway.  
 Treatment of ore from Victoria for Mr. J. Cochran.  
 Cyanidation of tailings from the Lady Gladys Gold Mine for Mr. M. C. Cocker.  
 Treatment of tailings from the Beryl Gold Mines for Mr. H. Urquhart.  
 Cyanidation of tailings from Menzies for Mr. R. P. Terrell.  
 Treatment of ore from the Callion Gold Mine for Mr. C. M. Harris.  
 Treatment of ore from the De Beers Gold Mine for Mr. W. J. Creagan.  
 Treatment of concentrates from the Cosmopolitan Gold Mine for Mr. N. T. Francis.  
 Cyanidation of tailings from Mt. Jackson for Mr. F. R. Mann.  
 Treatment of ore from the Banker Gold Mine for Mr. H. Annear.  
 Treatment of ore from Ravensthorpe for Mr. T. H. Daniels.  
 Flotation and cyanidation of tailings from the Paris Mines for Mr. K. C. McSwain.  
 Cyanidation of slimes from the Devon Consols Gold Mine for Mr. R. H. Fox.  
 Treatment of ore from the Big Four Gold Mine for Mr. W. H. Wood.  
 Cyanidation of concentrates from Kununalling for Mr. E. Rathjen.  
 Cyanidation of slimes from the Lone Hand Gold Mine for Mr. R. H. Fox.  
 Cyanidation of slimes for Mr. R. H. Fox.  
 Cyanidation of pyritic ore from Southern Cross for the Pilot Syndicate.  
 Investigation of treatment methods at Hannans North Gold Mine for the Broken Hill Proprietary Company.

In addition, the research metallurgist, with the approval of the Hon. Minister, spent a fortnight on the plant of the Hannans North Gold Mine of the Broken Hill Proprietary Company, Limited, endeavouring to overcome the initial difficulties experienced in the cyanidation of the company's ore by continuous counter current decantation.

The number of assays and chemical determinations carried out in connection with the metallurgical investigations has been as follows:—

Assays for gold	.. ..	1,543
Chemical determinations	.. ..	902

At the end of 1932 the metallurgical laboratory cadet, Mr. A. M. Smith, received an appointment as assayer with Norseman Gold Mines, Limited, where he has been able to put to practical use the knowledge he obtained both from class work and from assisting Mr. Clarke in the research work. His position was filled by the appointment of Mr. H. R. Dunstan, as cadet.

The Research Metallurgist, Mr. W. G. Clarke, has experienced an extremely busy year, as will be seen from the number of investigations undertaken and completed, and has spared no effort in supplying detailed information of value as a guide in the treatment of the samples of ore and residues submitted for investigation.

In addition to investigations into the treatment of Western Australian ores and products a short investigation was conducted on the treatment of a high-grade pyritic silver-gold ore from Victoria, and it is expected that the school will be called upon early next year to work out a treatment scheme for an ore from Forsayth, North Queensland, which is being forwarded by Commonwealth Mines Preliminary Syndicate at the suggestion of Mr. G. C. Klug, General Manager of Bewick, Moreing & Co., who is a staunch supporter of this school, and holds a very high opinion of the value of the experimental metallurgical work carried out by the school. It is probable also that the school will be called upon to investigate the treatment of a sample of ore from Temora, New South Wales.

The fact that mining companies in other States are beginning to make use of the facilities offered by this school is a distinct compliment to the school, and indicates that the value of the experimental work conducted in the metallurgical laboratory is recognised throughout the Commonwealth.

#### PUBLIC ASSAY DEPARTMENT.

As a result of the continued activity in prospecting for gold the number of free assays and mineral determinations again shows a marked increase over that for the previous two years. Not only have free assays and mineral determinations been carried out for prospectors, but, in addition, advice has been given regarding the nature of the ore bodies and possible methods of treatment of the ores. The number of free assays and mineral determinations carried out during the year has been as follows—

Gold	.. ..	1,983
Other metals, etc.	.. ..	16
Mineral determinations	.. ..	152
		—
Total	.. ..	2,151
		—

## STAFF.

Early in the year, in consequence of ill health, it became necessary for Dr. Larcombe, Lecturer in Geology, to take the long service leave of six months due to him. During his absence on leave the classes in Preparatory Mathematics and Mathematics I. were conducted by Mr. J. D. Murray, B.Sc., B.E., and the classes in Geology, Mineralogy, Petrology, and Mining by Mr. R. T. Prider, B.Sc., both of whom carried out their duties to the satisfaction of the school and the students. In this connection I have to express my appreciation of the kindness of the general managers of Lake View and Star, Ltd., and of South Kalgurli Consolidated, by whom Messrs. Murray and Prider are employed, in making it possible for them to conduct these classes.

The part-time instructors, Messrs. C. D. Slee (Fitting and Turning), J. B. McNeill (Engine-driving), and A. R. E. Bosustow (Internal Combustion Engines) have again satisfactorily carried out their duties. During the year the enrolment for Fitting and Turning became so heavy that on my recommendation the Hon. Minister approved of these classes being conducted on a third night each week so that all enrolled could be accommodated. Full advantage has been taken of the additional facilities afforded by this arrangement.

## GENERAL.

At the request of the Deputy Master of the Royal Mint, Major H. A. Corbet, Mr. Clarke, and myself have supplied technical information regarding sampling and assaying for inclusion in the brochure "Hints to Prospectors," issued by the Royal Mint. A large number of copies have been supplied to the school for distribution, and the demand for this useful publication has been very heavy in consequence of the information contained being particularly useful both to prospectors and to the operators of small treatment plants.

Mr. J. A. Agnew, Chairman of Directors of Lake View and Star, Limited, has continued to show his interest in and appreciation of the instruction given by the school by sending a young graduate in Metallurgy of the Royal School of Mines to take up a Mining Diploma Course while obtaining practical mining experience on Lake View and Star, Limited.

Graduates of the school continue to uphold its prestige, many of them holding responsible administrative and technical positions of importance with mining companies, not only in Western Australia, but also in other parts of the world.

During the year the Australian Institute of Mining and Metallurgy held its annual meeting in Kalgoorlie, the public meetings of the institute being held at the School of Mines.

The Students' Association, which constitutes the channel of communication between the students and the Mines Department, through the Principal, and also controls and organises the sporting and social activities of the school, has again become a virile organisation, and has obtained the approval of the Hon. Minister to its request that membership of the Association be made compulsory on all students attending course classes. This will insure that the Association will receive the support of the majority of students, instead of the minority as hitherto, and that the Association will therefore be enabled to enlarge its sphere of activity. It is hoped that the Association will be able to resuscitate the Mining, Metallurgical, and Engineering Society, which a few years ago was a strong organisation, whose object was the spread of knowledge by the reading and discussion of papers on technical subjects.

For the first time since affiliation of the School of Mines with the University of Western Australia it has been necessary to provide instruction in the subjects of the fourth and fifth years of the course in Mining for the degree of Bachelor of Engineering. Arrangements have been made with the Faculty of Engineering for the student taking this course to receive instruction in the recognised subjects, and for the University to recognise the School of Mines examinations in these subjects.

In past years the number of entrants for the Junior Scholarship has been small, mainly on account of the fact that insufficient co-ordination exists between the curriculum of the State schools and the syllabus of the subjects of examination for the Scholarship. During recent years Geometry and Physical Geography, as required for the Junior Scholarship, have not been taught in the State schools, and as the winner of the Scholarship is required to take up these subjects at a higher standard when he enters the School of Mines, it is essential that he should have at least a fundamental knowledge of the subjects. I understand that a new curriculum for the State schools is now under consideration, and that provision is made therein for the teaching of these subjects up to the standard required for the Junior Scholarship. If this curriculum is adopted there should be better competition for this Scholarship.

I have to express my appreciation of the work of the staff throughout the year under somewhat difficult conditions, which will be to some extent ameliorated by the appointment of an Assistant Lecturer in Mathematics and Chemistry at the beginning of 1934.

Statistics dealing with the enrolment of students and the results of the annual examinations are attached hereto.

B. H. MOORE,  
Principal School of Mines.



## DIVISION VI.

# Annual Report of the Inspection of Machinery Branch, Mines Department, for the Year 1933.

*The Under Secretary for Mines.*

For the information of the Hon. Minister I am submitting herewith the report of Mr. W. Churchill, Deputy Chief Inspector of Machinery, on the administration of "The Inspection of Machinery Act, 1921," for the year ended 31st December, 1933.

The volume of work carried out by this branch of the Department has again shown an increase, and it is pleasing to note that the total number of accidents to persons caused by machinery was 29 only; unfortunately, four of these were fatal.

The financial position is satisfactory, the excess of revenue over expenditure for the year being £1,005 5s. 3d.

Mr. A. M. Howe, Chief Inspector of Machinery, who is also State Mining Engineer and Chief Inspector of Mines, has, unfortunately, been seriously ill, and has been away on ordinary and sick leave since 25th September, 1933. His absence necessarily threw an increased amount of work and responsibility upon Mr. D. F. Browne, who carried out his duties as well as his own, and also upon Mr. W. Churchill.

Mr. B. Pryn Jones, Deputy Chief Inspector of Machinery, retired from the service in January, having reached the age limit, and, I regret to say, has since died. In last year's annual report Mr. Howe made a fitting reference to this officer's fine record of service. Mr. W. Churchill was appointed to the position of Deputy Chief Inspector of Machinery rendered vacant by Mr. Pryn Jones' retirement as from 31st January.

RICHARD C. WILSON,

Acting Chief Inspector of Machinery.

9th May, 1934.

*To the Acting Chief Inspector of Machinery.*

Sir,

I have the honour to submit for the information of the Hon. the Minister for Mines the following report on the operations of "The Inspection of Machinery Act, 1921," in the districts proclaimed thereunder, together with statistical tables for the year ended 31st December, 1933.

For convenience of reference the report is divided as follows:—

1. Inspection of Boilers, New Construction, Maintenance.
2. Explosions—Interesting Defects—Tests.
3. Inspection of Machinery.
4. Prosecutions under the Act.
5. Accidents to persons by Machinery or Boilers.
6. Engine-drivers' Examinations and Kindred Matters.
7. General—Staff—Mileage.
8. Revenue and Expenditure.

## DIVISION I.

### *Inspection of Boilers.*

The total number of boilers and pressure vessels upon the register, classed as fit for service, at the close of the year on 31st December, 1933, is now 3,784, as compared with 3,722 on 31st December, 1932; thus showing a net increase of 62.

The number of boilers, particulars of which are recorded, known to be in districts as yet unproclaimed remains unaltered, viz., 52. It is possible there are some few other boilers of which we have no record in existence in remote parts of the State which, under present circumstances, it is not possible to register.

During the year there has been a total addition of 77 to the list of useful boilers and pressure vessels; of these, two are old boilers previously condemned which have been reconditioned and re-installed. One previously registered in this State, but transferred to the Eastern States, has this year been returned to this State. One boiler has been transferred to this Branch from another State Department. Of the remaining 73 new vessels registered 10 of these were imported from the United Kingdom, five from United States of America, 28 from Eastern States, 11 from sources untraced, and 19 constructed locally. Of those vessels locally constructed four were digesters, six air receivers, two vulcanizers, three locomotive type portable boilers, three stationary underfired multitubular boilers, and one portable water tube boiler. Although the proportion of locally built vessels is only 14 per cent. of the total new registrations, it is gratifying to note that there is some revival in the construction of boilers and pressure vessels within the State. Of the total number of new registrations, 16 of these are working in gold-fields districts attached to the Kalgoorlie office, and the remaining 57 are working in districts attached to Perth office.

The deductions in number for the year ended 31st December, 1933, have been as follows:—Boilers and pressure vessels condemned 13, vessels transferred to other States 2, total 15; which number deducted from the total 77 leaves a net increase of 62 previously noted.

The total number of internal and external inspections of boilers and pressure vessels made during the year 1933 was 1,567, as compared with a total of 1,467 for the year 1932; thus showing an increase of 100 inspections for this year, apportioned as follows:—an increase of 72 in the districts attached to Perth office and an increase of 28 in the districts attached to Kalgoorlie office.

The number of inspections under working conditions recorded is only 22, but in this connection many smaller vessels are inspected under steam pressure in addition to being inspected when "cold," and are also subjected to hydraulic tests for which no separate reports are made, such being recorded on the

general report forms only.

Recently more attention generally has been given to the matter of inspections under steam and to hydraulic tests than was possible formerly.

The total number of certificates for boilers and pressure vessels issued during 1933 is 1,577, as compared with 1,465 for the year 1932; thus showing an increase of 112 for this year apportioned as follows:—an increase of 87 in Perth districts and an increase of 25 in Kalgoorlie district.

The number of repair notices issued during the year 1933 is 332, being a close approximate to the number issued during 1932, which was 335.

#### Constructions.

As an instance of the extreme variety of pressure vessels dealt with by this Department, designs were submitted during the year of a spherical gas holder about 40 feet in diameter to be suitable for a working pressure of 50 lbs. per square inch, such construction to be subject to the satisfaction of this Department, in addition to many types of vessels to be used as air receivers, vulcanizers, etc., all of which are subject to the certificates of this Department. Another vessel of interest constructed during this year is a small water tube boiler composed of hydraulic tubing and portions of gas transport cylinders or containers, so arranged as to be portable for use in conjunction with a small engine for tree pulling. The working pressure of this boiler is 750 to 800 lbs. per square inch, and it is reported that although using feed water from creeks or surface pools, practically no trace of scale or deposit is found inside this boiler, and working results have been so far quite satisfactory.

A further new construction of interest is a vessel built of stainless steel for a process of food manufacture. The working of this material was a new experience for the manufacturer. Unfortunately, one of the cast-iron ends was defective under hydraulic test, also the method of attaching the stainless steel shell to the cast-iron ends was not satisfactory. On the suggestion of this Department bolts were substituted for riveting and this alteration, together with a new casting for the end thickened up where previously found defective, enabled a vessel to be completed which has proved quite satisfactory.

Many unfired pressure vessels have been constructed entirely by welding, and have so far given good results under somewhat severe tests, but this practice has not yet been adopted to any great extent in the construction of steam generators in this State, possibly because there is not sufficient of such work offering to attract welders expert in this class of work, and nothing short of the highest class of welding can be permissible in the construction of steam generators.

Welding of this class has not yet reached the condition of reliability in this State attained in other countries where such work is carried out under a rigid system of inspection and testing as the work progresses, such as enables manufacturers to guarantee within a narrow margin of accuracy the efficiency and strength of welded work.

#### Repairs.

In reviewing the work for the year under the above heading not only must account be taken of the amount of work involved in maintaining existing

boilers and pressure vessels in a condition of safety, but a considerable amount of work has been done in the direction of reconditioning old vessels, which has been necessitated principally as a result of the revival of goldmining and to a lesser extent by the demand of other industries for steam vessels for heating and other purposes. As the cost of importing new boilers, or even the material required to make new boilers, is so great, resort must be made to the expedient of reconditioning old boilers, in some cases amounting to the practical reconstruction of vessels which, under more favourable conditions, would not have been worth such expenditure had it been possible to obtain new boilers.

A considerable amount of extra work is entailed in connection with the reconditioning of old boilers where such work is under supervision during progress, and is followed by the hydraulic test, and where practicable test under steam pressure on completion of work before certificates are granted. Many such extensive repairs have been carried out, and one entirely new boiler for a small locomotive has been built to replace one condemned.

Autogeneous welding continues to take a conspicuous part in the repairs and reconditioning of boilers, particularly in the matter of filling or building up pitted and wasted areas where the question of strength is not of extreme importance, but rather the prevention of leakage. Each repair is considered on its merits, and no extensive application is sanctioned where such welding would be subject to extreme temperature or highly stressed conditions.

#### Maintenance.

Maintenance generally has been well up to standard, particularly in the case of the more important boilers; the few cases of poor maintenance reported as a rule refer to isolated small boilers used for heating purposes. In this direction the practice of having all attendants certificated wherever practicable has had a beneficial effect in insuring better maintenance and safe working conditions.

Return No. 1, showing Classification of various types of useful Boilers in Proclaimed Districts on 31st December, 1933.

Types of Boilers.	Districts worked from Perth.	Districts worked from Kalgoorlie.	Unproclaimed Areas.	Totals.	
				1933.	1932.
Lancashire ... ..	49	53	...	102	102
Cornish ... ..	219	371	...	590	590
Semi-Cornish ... ..	34	15	...	49	49
Vert. Stat. ... ..	366	284	...	650	648
" Port. ... ..	73	8	...	81	81
" Mult. Stat. ... ..	39	19	...	58	56
" Port. ... ..	27	3	...	30	30
" Pat. Tubular ... ..	8	...	...	8	8
Loco. Rect. Firebox Stat.	97	44	...	141	141
" " Port.	268	38	...	306	302
" Circ. " "	144	3	...	147	147
Locomotive ... ..	76	39	...	115	115
Water Tube ... ..	111	115	...	226	225
Return Mult. Underfired Stat. ... ..	93	50	...	143	139
Return Mult. Underfired Port. ... ..	3	4	...	7	7
Return Mult. Int. Fired Stat. ... ..	41	5	...	46	46
Return Mult. Int. Fired Port. ... ..	2	...	...	2	2
Egg ended and other types not elsewhere specified	40	17	52	109	107
Digesters ... ..	71	5	...	76	73
Air Receivers ... ..	336	126	...	462	445
Gas Receivers ... ..	4	...	...	4	4
Vulcanizers ... ..	212	8	...	220	196
Steam Jacketed Vessels ...	206	6	...	212	209
Total registrations useful boilers ... ..	2,519	1,213	52	3,784	3,722
Total boilers out of use, 31st December, 1933	1,238	914	...	2,152	2,205

## DIVISION II.

*Explosions—Interesting Defects and Tests.*

For the year 1933 I have again the satisfactory duty to record the fact that there has been no explosion of any boiler or pressure vessel subject to inspection under the provisions of Inspection of Machinery Act. This is all the more satisfactory, in view of the great variety of such vessels and the difficult conditions under which inspections at times are made. Such vessels include steam generators carrying working pressures ranging from 10 lbs. per square inch up to 750 lbs. per square inch, and air receivers carrying working pressures up to 1,000 lbs. per square inch.

The tendency towards higher working pressures calls for extra vigilance on the part of the inspectors and the necessity to keep constantly in touch with the latest methods of construction and repairs. Many other boilers are now of considerable age and so demand special consideration on this account.

An opportunity was availed of during the year to have test strips cut from three boilers all about 40 years of age, with the following results:—

—	Tensile. tons per sq. in.	Elonga- tion. % in 8"	Bending.
No. 1—Steel plate ...	31·4	21·9	Satisfactory.
No. 2— Do. ...	29·3	17·6	do.
No. 3—Wrought iron plate	20·8	5·9	Fractured when bent to 40 deg.

The results of these tests have confirmed the conclusions already recorded in other countries to the effect that wrought iron appears to be more susceptible to change in physical properties by age and fatigue stresses than is mild steel, and for this reason a visual inspection only of boilers constructed of wrought iron plates may be misleading because as a rule wrought iron plates resist the wastage due to pitting and corrosion to a much greater extent than mild steel plates, and it is a frequent occurrence that boilers constructed of wrought iron plates are reported to be in particularly good condition.

Also Brinell hardness tests were applied to a piece of plate from the flanging of the throat plate of a loco type boiler of a steam road roller. Such test gave the very high reading of 187 average of four impressions. This portion of the plate was found so brittle that pieces were broken out of this by blows with a hand hammer. On account of this and other defects it was necessary to order practically a new boiler.

Certain repairs by electric welding have been proved to be ineffective; such were sanctioned more or less as an experiment because their failure would not result in any serious consequences. I refer to the building up by electric welding of the uptakes of vertical boilers. It is found that such repair is not a satisfactory substitute for the renewal of a badly wasted uptake.

A case of damage to a vertical boiler caused by shortage of water occurred. The riveted seams were severely strained and became leaky. The fusible plug was found to be of a type which would not easily be operative until the plate became extremely hot; the metal filling in this case was not melted.

A large number of vulcanizers are now in operation, and a case is reported where the small mild steel boiler attached to one such vessel was found seriously corroded and had to be renewed after a term of service of only three years.

## DIVISION III.

*Inspection of Machinery.*

The total number of registrations of machinery classed as in service on the 31st December, 1933, is 10,076, as compared with 9,550 on 31st December, 1932, showing an increase of 526 for this year.

This increase has been principally in the direction of electrically driven plants of which no less than 481 extra registrations have been made, the remaining net increase of 45 being accounted for as follows:—Groups driven by oil engines 36, gas engines 9, compressed air 1, hydraulic power 1, total 47; whilst the steam driven groups have been decreased by 2, leaving the net increase of 45 which, added to 481 electrically driven groups, makes the total increase of 526 for the year 1933.

The total number of inspections made during the year is 7,555, as compared with 7,235 for the year 1932, an increase of 320 for this year. Of this increase in number of inspections, 225 are in districts worked from Perth and 95 are in districts worked from Kalgoorlie.

During the year, 371 notices were issued for guarding, fitting of safety appliances, and other attentions to machinery for the prevention of accidents, the number corresponding closely with that for last year, viz., 366.

It will be noted there is again a satisfactory increase in the work of this Branch which points to a steady improvement in the position as regards industrial activities. During the year permits have been issued for the erection of four new lifts, two of these being passenger lifts, one hospital patients' lift, and one service lift.

Considerable attention has been devoted to the matter of automatic control lifts, especially as regards the equipment of enclosure doors, which it has been found necessary to make not only safe in the ordinary sense of the application of this term, but to make such as nearly "fool-proof" as possible. This Branch, well knowing the defects inherent in appliances of an automatic nature, has in the past had conspicuous notices posted, warning persons who made use of such lifts to exercise caution before attempting to open any lift enclosure door, but experience has shown that such warning is disregarded by many persons. For this reason it has been decided to adopt the principle of fitting secondary locks upon all such enclosure doors. This is in accordance with the Lifts Code of the Australian Standards Association, and although this may not entirely prevent accidents, it will at least greatly minimise such risks.

There is now a total of 258 lifts in the metropolitan area, being an increase of eight actually completed in erection during this year, permits having been issued for some of these during 1932.

Of these new installations, three lifts at Shell Building are of particular interest in that these embody practically the latest practice in power equipment and safety appliances. One new lift was completed at Airways House and one second-hand lift

was imported from the Eastern States, reconditioned, and installed for service of a light nature only.

Of new machinery installed during the year, the most important development has been upon the gold-fields, where a particularly fine ore treatment plant has been erected at the Perseverance Gold Mine, Kalgoorlie, which has proved so satisfactory that this plant is now being duplicated.

The Great Boulder Proprietary, Ltd, is erecting a new treatment plant, the contract for which has been placed in the Eastern States.

The Lake View and Star, Limited, are reconstructing and concentrating their steam generating plant, thus abolishing some lengthy steam pipe ranges and otherwise improving the efficiency of the steam section.

The adoption of bulk-handling of wheat has been responsible for the installation of a considerable amount of new machinery both at the shipping ports and at the various railway sidings so equipped.

A slight revival in the timber industry has brought a certain amount of idle plant into use again, but has not warranted any outlay on new machinery, some of which, particularly in the locomotive section, is due for replacement and which can only be retained at the cost of expensive repairs, and new locomotives will be imperative if any material revival of trade should occur.

In the dairying industry, which is making steady progress, one new cheese factory has been established at Balingup.

In other industries the position remains much the same as in 1932.

*Return No. 2—Showing Classification of various Sources of Power-driven Machinery in use or likely to be used again in Proclaimed Districts for Year ended 31st December, 1933.*

Classification.	Districts worked from Perth.	Districts worked from Kalgoorlie.	Totals.	
			1933.	1932.
No. of groups driven by steam engines	686	358	1,044	1,046
No. of groups driven by oil engines ...	1,415	143	1,558	1,522
No. of groups driven by gas engines ...	123	95	218	209
No. of groups driven by compressed air ...	7	37	44	43
No. of groups driven by electric motors ...	6,253	955	7,208	6,727
No. of groups driven by hydraulic pressure ...	4	...	4	3
	8,488	1,588	10,076	9,550

*Return No. 3—Showing Classification of Lifts on 31st December, 1933.*

Type.	How Driven.	Totals.	
		1933.	1932.
Passenger ...	Electrically driven ...	138	131
	Hydraulically driven ...	1	1
Goods ...	Electrically driven ...	110	110
	Hydraulically driven ...	3	2
	Belt driven ...	6	6
		258	250

#### DIVISION IV.

##### *Prosecutions under the Act.*

Again it has not been necessary to institute proceedings against any firm or person for breaches of the "Act" during the year. It is the experience of this Branch that owners of machinery and boilers are always willing to comply with any reasonable requirements for the better safe-guarding of machinery and safe working of boilers and pressure vessels, the advice and assistance which Inspectors are able to impart being particularly appreciated.

As might only be expected during this period of financial stringency there are some cases where extreme measures had to be taken in order to recover fees due. In some few cases the small amounts owing had to be written off, the debtors having gone out of business.

#### DIVISION V.

##### *Accidents to Persons by Machinery or Boilers.*

The total number of accidents recorded which have been the subject of investigation during the year ending 31st December, 1933, is 29, of which four were fatal, as compared with a total of 29, of which seven were fatal in the year 1932.

When it is considered that some 526 groups of machinery and 62 boilers have been added during the year, making a total of 10,076 groups of machinery, and 3,784 boilers and pressure vessels in service, the comparatively small number of accidents must reflect to a great extent the efficiency of the work of this Branch, as this is the only standard by which the work of this Branch can be gauged from the point of view of the purpose for which the Inspection of Machinery Act was enacted, viz., the prevention of industrial accidents.

Of the four fatal accidents, one was caused by the bursting of an emery wheel. This was a second-hand wheel which was carefully examined by a competent mechanic who, with a magnifying glass, did not detect any flaw before proceeding to mount this wheel. The wheel when mounted was speeded up carefully, an assistant standing by the motor switch. The mechanic stood to one side of the wheel, and at the same time warned another employee who was near to stand out of line. This latter person moved out of line, and on the wheel speed being increased it suddenly burst, a piece of the wheel striking a large casting by which it was deflected and so struck the person who had deliberately moved, as he thought, to a safe position. He was injured in the lower part of the leg, and subsequently died as a result of shock and loss of blood. On subsequent examination of parts of the broken wheel evidence of internal old flaws was disclosed, radiating from the centre hole outwards. This accident is one which all reasonable precautions were taken to prevent, short of discarding the wheel, for which there was no apparent justification.

One fatal accident, although caused by a passenger lift, was not due to any defect of the lift. Painters and renovators were working in the building, and definite instructions were issued to ensure that no work should be done about the lift when the lift was running. The deceased painter, without notifying the lift driver, mounted a step ladder and proceeded to work on the outside of lattice work above an enclosure doorway. For some reason—it is surmised to clean off paint which had gone through the lattice work—he put his head and arm inside the enclosure and was crushed by the descending car. The driver of the lift, travelling downwards, was unaware of the presence of the painter until the accident occurred.

One fatal accident was caused by a circular saw-bench used for cutting up firewood on farming property. The sawbench and saw were practically new and had just been put into service, being driven by the engine of an oil tractor. Work commenced in the morning, and the saw was stopped once or twice for sharpening. The deceased was operating the saw, and was a careful worker. It was stated that he tried to tighten the nut on the saw spindle after sharpening the saw. About 4 p.m., without any warning, the saw fractured and a piece struck deceased on the thigh. He was taken to hospital (about 25 miles away), but subsequently died as a result of shock and loss of blood. On investigation it was found that the cap and bolts of the bearing nearest the saw had fractured, causing the saw to be displaced, which in turn was broken by contact with the side of the bench. The bearing cap was of cast-iron of poor design, and showed signs of a flaw having existed for some time. This sawbench had not been inspected prior to the accident: being new, it was considered to be in good order.

The fourth fatal accident occurred at a timber yard. The deceased was a foreman in charge of the woodworking machinery, which was driven by an electric motor. The line shafting runs in a trench under the flooring. For some reason the deceased, wearing a strong leather apron, entered this trench without first stopping the motor. There was no witness of this accident. The deceased, being missed, a search was made, and his body was discovered in this trench. Evidently his apron had been caught by a revolving pulley or belt. At the inquest it was stated that deceased's duty was to use the switch and stop the motor, if any risk was impending, as he was solely in charge. He had been working on this plant for twenty years, and bore the reputation of being most careful and conscientious. For some reason unknown, he took an unnecessary risk on this occasion.

Of the serious but non-fatal accidents one occurred in connection with a passenger lift, the injured person falling from the ground floor entrance to the basement of the well. There was no eye witness of the occurrence, the lift was unattended and was under automatic push-button control. By some means the enclosure door was opened when the car was not at this entrance. This lift is fitted with an illuminated indicator showing the position of the car, and the car is fitted with an illuminated threshold or floor nosing. Also there is a warning notice; yet all these

safeguards were of no avail to prevent the injured person stepping forward once the door was opened. A further safeguard has now been fitted in the form of secondary door locks, and this practice is being adopted in the future, wherever practicable, in the case of automatic lifts.

A severe electric shock received by the driver of an electric winding engine when taking hold of his control handles was discovered to have been caused by the presence of a rat at the back of a switch-board having short-circuited two terminals. The earthing of the winding machinery not being fully effective, was responsible for another accident, and so an entirely new earthing system has now been fitted.

A large steam mangle or calender at a laundry was the cause of a severe burning accident, which, but for prompt action, might have been more serious. In the absence of the person in charge, two junior girls started the machine, contrary to all regulations, and one girl had her hand caught by the hot rollers, the hand being badly crushed and burnt.

One engine-driver was seriously burnt by escaping gases and hot oil caused by an explosion in the crank case of a Diesel engine. Slight alterations have been made in the arrangement of air intake of this engine, and no further explosions have occurred.

Other accidents recorded during the year have been of a less serious nature by various causes, such as accidental contact with cutters of woodworking machinery, crushing of fingers by tin-pressing machine, and one case of girl's hair being caught on a small revolving spindle of a cloth-cutting machine. Most of these accidents might have been obviated by the exercise of more care on the part of operators.

In the Goldfields districts it is pleasing to record there has been no fatal accident during the year. Many new plants are being erected, and the work involved in inspection has consequently increased.

Six cases of mishaps on winding engines have been reported during the year, all of these having been "overwinds." In only one case was any personal injury involved, and this was fortunately not more serious than a temporary immersion in water at the bottom of the shaft. This was due to an experimental replacement of single deck cages by double deck cages of much heavier design. The matter was not submitted to this Department before new cages were made and installed. The scheme was being tested at the time. It was found that the weight of this new double deck cage at the bottom of the shaft was excessive for the winding engine, which could only lift this load from a certain advantageous position. As a result, the double-deck cages have not been put into service. Had this matter been submitted to this Department in the first instance, the cost of making and experimenting with these double-deck cages might have been avoided.

When the number of winding engines in use in this State, and the number of persons who daily travel in the cages operated by these engines is considered, it is very satisfactory to be able to record so few accidents, and such conditions speak well for the type of engine-drivers who operate such engines and the system of inspection applied to such operations.

Return No. 4, showing Persons Killed or Injured by Boiler and Machinery Accidents in Proclaimed Districts during Year ended 31st December, 1933.

( ) Numbers within parentheses denote fatal accidents.

Class of Machinery.	Districts worked from Perth.	Districts worked from Kalgoorlie.	Total.
<i>Tin Working—</i>			
Cannister-making press ...	1	...	1
<i>Metal Working—</i>			
Emery Wheel ... ..	1 (1)	...	1 (1)
<i>Sawmilling and Woodworking—</i>			
Circular saw ... ..	7 (1)	...	7 (1)
Buzzer ... ..	3	...	3
Rabbeter ... ..	1	...	1
Thicknesser ... ..	1	...	1
Docking saw ... ..	1	...	1
<i>Ore Treating—</i>			
Battery cam ... ..	...	1	1
<i>General—</i>			
Electric winder (shock) ...	1	...	1
Belting ... ..	2 (1)	1	3 (1)
Diesel engine ... ..	1	...	1
Passenger lift ... ..	3 (1)	...	3 (1)
Cloth cutting ... ..	2	...	2
Steam mangle ... ..	1	...	1
Peel cutter ... ..	1	...	1
Dough roller ... ..	1	...	1
	27 (4)	2	29 (4)

#### DIVISION VI.

##### *Engine-drivers' Examinations and Kindred Matters.*

In this section of the work of this Branch there is also satisfactory progress to report. During the year a total of 225 certificates have been issued to engine-drivers and boiler attendants, the corresponding number for 1932 being 159, thus showing an increase of 66.

Coincident with this increase in certificates granted is an increase in the number of examinations held, and during the year examinations have been held, as follows, at the following centres:—Perth 4, Kalgoorlie 2, Leonora 2, Wiluna 2, Meekatharra 2, Geraldton 1 and Bunbury 2. Examinations were held at all centres for which such were advertised.

The travelling Board of Examiners, in addition to spending 19 days actually conducting examinations at the various centres named, has been occupied on a further 28 days in Perth on board meetings dealing with applications, examination papers, inquiries, and general board business. The time travelling to the various centres for examination and inquiries into matters appertaining to engine-drivers and boiler attendants has occupied 27 days.

A total of 271 applications have been received and dealt with, and the total number of certificates granted is 225 for the year.

##### *Complaints, Inquiries, etc.*

During the year 12 complaints of various kinds have been dealt with regarding the employment of engine-drivers or boiler attendants, who were either uncertificated or did not hold the required certificate for the work on which they were being employed. In none of these cases was the offence of a serious nature, and the matters subject of dispute were satisfactorily adjusted.

The personnel of the board has suffered by the absence of Mr. A. M. Howe, who as Chief Inspector of Machinery is Chairman of the Board of Exam-

iners, and who, unfortunately, has been too ill during the latter part of the year to attend meetings or take any active part in proceedings; consequently, the duties appertaining to the position of chairman have devolved upon the present Deputy Chief Inspector of Machinery.

The travelling Board of Examiners also was subject to a change of personnel, the present Deputy Chief Inspector of Machinery, Mr. W. Churchill, having relieved Mr. B. Prynne-Jones, late Deputy Chief Inspector of Machinery, retired as from 31st January, and Mr. J. Breydon, having been granted extended leave of absence, his position was taken by Mr. G. A. S. Bradshaw.

Return No. 5 showing total number of Engine-drivers and Boiler Attendants' Certificates (all classes) granted in 1933 compared with 1932.

	No. granted. 1933.	1932.
Winding Competency, including certificates issued under Regulation 40 and Section 60 of Act	5	7
First Class Competency, including certificates issued under Regulations 40 and 45 and Sections 60 and 65 of Act	11	10
Second Class Competency, including certificates issued under Regulation 40 and Section 60 of Act	25	22
Third Class Competency, including certificates issued under Regulation 45 and Sections 60 and 63 of Act	27	20
Locomotive Competency	3	3
Traction Competency	1	—
Internal Combustion Competency	27	27
Crane and Hoist Competency	8	6
Boiler Attendant Competency	112	54
Interim	1	2
Copies	1	4
Transfers	4	4
Totals	225	159

#### DIVISION VII.

##### General.

I have again to report that "The Inspection of Machinery Act 1921," has remained unaltered, notwithstanding that certain amendments are required in order that provisions of the Act may be made applicable to certain classes of machinery which have been in use now for some years past, and for which there is no adequate provision in the Act. I refer particularly to winding engines driven by electric motors direct and smaller winding engines driven by internal combustion engines directly or indirectly. Many other matters also need review, but the time is not opportune to deal with such at present.

A certain amount of work has been undertaken by the Branch in an advisory capacity for other Departments, in the way of recommendation and valuation of machinery, etc. In this connection the records and special experience of the officers of this Branch have been found to be of much value to other departments, and are appreciated accordingly.

Work in connection with the Standards Association of Australia has been somewhat neglected this year, owing to the pressure of increased current work, changes in staff, and extra work entailed by examinations of engine-drivers, etc., which alone has necessitated a considerable amount of overtime work on my part. This neglect of Standards Association work has been unavoidable.

##### *Inspectorial Staff.*

The year 1933 has been marked by many changes in regard to the staff of inspectors. Mr. B. Prynne-Jones, an officer of 30 years of service and experi-

ence as an Inspector of Machinery and latterly Deputy Chief Inspector, the highest position available to inspectors, having reached the age limit of 65 years, was retired from active service in January. Mr. W. Churchill, being the successful applicant for this position, took over the duties of Deputy Chief Inspector of Machinery as from 31st January. The next senior inspector, Mr. G. Moore, being stationed at Kalgoorlie, it was necessary to transfer this officer to Perth to take up the position of Senior Inspector; Mr. W. Jordan being transferred to Kalgoorlie. This necessitated the taking over of the Great Southern district work by Mr. R. W. Frankish, and the Metropolitan and Suburban work relinquished by Mr. Frankish was taken over by Mr. W. H. Sherman, who was appointed to permanent staff on 1st March. No change was necessary with regard to South-Western and Murchison districts, which have been retained by Mr. R. J. Ross and Mr. D. R. MacGregor respectively.

The inspectorial staff was increased by the appointment of Mr. J. F. Winzar, who commenced duty as a temporary officer on 11th November, 1933. This appointment now makes the staff requirements complete, so far as can be anticipated for some years ahead, and will enable leave to be taken as it falls due by other inspectors, a position which has not existed for many years past.

#### *Clerical Staff.*

Changes in the clerical staff have also occurred during this year, although of a temporary nature only, due to the absence on long service leave of the Clerk-in-Charge, Mr. H. W. Gibson. To meet this situation temporary assistance has been given by Mr. Parry, and the duties of Clerk-in-Charge have been carried out by Mr. J. W. Smith.

#### *Mileage.*

The total mileage travelled in the various districts during the year is 44,987, as compared with 41,901 for the year 1932, thus showing an increase of 3,086 miles this year.

Of the above total mileage, 42,844 was by road, 2,085 by rail, and 58 by water. The principal increase has occurred upon the goldfields, where the increased activity in mining has necessitated travelling to many outlying districts which have been resuscitated and additional visits to older centres, where increases in plant and equipment necessitate more frequent inspection, such centres being at considerable distances apart: the extremities of the districts worked from Kalgoorlie being so far apart as Southern Cross, Wiluna, Laverton, and Norseman, which, if the work increases materially, will necessitate at least part-time assistance from Perth.

As pointed out in previous years the mileage travelled by motor cars is practically equivalent to the total depreciation of one car per year, and, if efficient service is to be maintained, an allowance for

at least one new car per year is necessary. Experience during the year of the practice of keeping old cars in service has proved most uneconomical, the cost of repairs in some cases exceeding the value of the car. Inspectors of this Branch are mechanical engineers and capable of keeping a car in good order, and it is this fact alone which has kept old cars in running order long after their economical mileage limit. Such cars, under less skilled control, would have been discarded much earlier.

### DIVISION VIII.

#### *Revenue and Expenditure.*

The financial results of the operations for the year show a further increase in revenue earned, the total amount being £6,152 8s. 1d., as compared with £5,656 14s. 7d. for the year 1932, thus showing an increase of £468 13s. 6d. The three sources of revenue each show an increase: fees for boiler inspection being £2,290 9s. 11d. as compared with £2,126 4s. 6d. for 1932; fees for machinery inspection £3,489 8s., as compared with £3,271, 5s. 11d. for 1932; and fees for engine-drivers' examinations, etc., £291 18s., as compared with £205 12s. 6d. for 1932. Incidentals—sale of copies of Act, etc., show an increase of 6d. only.

The expenditure has naturally been increased as a result of the increased number of inspections made, the total expenditure being £5,120 2s. 10d., as compared with £4,667 8s. 3d. for the year 1932; thus showing an increase of £452 14s. 7d. The increase is almost wholly accounted for by the purchase of one new motor car, and heavy expenditure on upkeep of old cars under the heading of incidentals, which items show an increase of £459 7s. 6d. for this. The expenditure on account of engine-drivers' examinations, etc., has increased by £43 0s. 4d., accounted for by the extra examinations held during the year.

To summarise the result of the financial operations for the year the equipment has been improved by the purchase of one new car at a cost of £350, whilst an amount in the region of £200 has been expended in reconditioning old cars. A small sum has been expended upon tools and appliances necessary for inspection purposes, leaving a balance of £1,005 5s. 3d. excess of revenue over expenditure for transfer to Treasury, as compared with the amount of £989 6s. 4d. for the year 1932, in which year no new car was purchased.

In conclusion, I desire to tender my best thanks to officers of other Departments, who have rendered assistance in matters concerning the administration of this Act, and to record my appreciation of the good work carried out by the staff of this Branch in completing an arduous and, I trust will be considered, a satisfactory year of work.

W. CHURCHILL,

Deputy Chief Inspector of Machinery.

24th April 1934.

## DIVISION VII.

## Annual Report of the Chemical Branch, Mines Department, for the Year 1933.

*The Under Secretary for Mines.*

I have the honour to present, for the information of the Hon. Minister for Mines, my annual report for the year 1933.

## STAFF.

I regret to record the death of Mr. C. E. Stacy, A.A.C.I., for many years Assistant Government Analyst and Toxicologist, and my deputy whenever I was absent from head office. He had been a professional officer of the department for 34 years.

Mr. H. Bowley, F.A.C.I., was appointed Assistant Government Analyst as from 1st October in his place.

In consequence of the excessive amount of work required to be done the staff had to be strengthened by the temporary appointment of two further units, a professional chemist and a general assistant.

## EQUIPMENT.

Owing to the reduced vote available the condition of the equipment leaves much to be desired. Minor items are being bought in a hand-to-mouth fashion, leaving us constantly in danger of not being able to replenish our supplies, when urgently wanted, of those many articles which can only be supplied from England. Several major pieces of apparatus are on their last legs, and when they break down, as inevitably they must before long, we shall have to refuse to accept any work requiring their use. This may seriously inconvenience several Government Departments, and put a temporary stop to valuable industrial research. An ultra-violet ray lamp is urgently required for the laboratory, this instrument being increasingly used all over the world in connection with the detection of crime and the adulteration of food-stuffs and various trade materials.

## VOLUME OF WORK.

The volume of analytical and investigational work, not to mention the innumerable instances in which technical advice is sought and given, has been so great as to strain the staff to the uttermost. This is in spite of the additional assistance mentioned above, and the "rationing" to a slight extent of all Government Departments, as well as the general public.

The total number of samples registered for chemical and physical investigation was 5,678, which were classified as shown in the accompanying table.

*Source and Allocation of Samples.*

Source, Department, etc.	Section 1. Foods, Drugs and Toxicology.	Section 2. Mineralogy and Geo- chemistry.	Section 3. Agriculture and Water Supply.
Premiers ... ..	5	4	...
Mines ... ..	38	1,132	...
Health ... ..	178	1	2
Agriculture ... ..	83	14	925
Public Works ... ..	4	9	86
Lands and Surveys ... ..	1	...	...
Chief Secretary ... ..	2	...	10
Forests ... ..	13	...	331
Police ... ..	135	...	1
Metropolitan Water Supply and Sewerage ... ..	1	...	365
Tender Board ... ..	184	...	...
Government Laboratory	20	65	87
Public Hospitals ... ..	17	...	1
Government Boards ... ..	9	1	...
Miscellaneous ... ..	5	...	1
Royal Agricultural Society ... ..	...	...	74
Public Pay ... ..	48	904	171
Public Free ... ..	12	734	5
Totals ... ..	755	2,864	2,059
Grand Total ... ..	...	...	5,678

The most numerous groups of materials dealt with in each section were:—

*Foods, Drugs and Toxicology Section—*

Toxicological specimens ... ..	189
Milk, bovine ... ..	70
Milk, human ... ..	60
Oils, lubricating ... ..	39
Cattle dip ... ..	24
Explosives ... ..	22

*Mineralogy, Mineral Technology and Geochemistry Section—*

Gold assays ... ..	2373
Mineral determinations ... ..	330
Silver assays ... ..	206
Mineral analyses ... ..	64
Tin assays ... ..	25
Lime assays ... ..	25

*Agriculture, Water Supply and Sewerage Section—*

Soils ... ..	1139
Water ... ..	547
Wheat ... ..	161
Flour ... ..	158
Fertilisers ... ..	70
Sewage ... ..	44



## DEPARTMENTAL COMMITTEES.

Meetings of the following committees were attended regularly, and problems investigated on their behalf:—

State Committee of the Commonwealth Council of Scientific and Industrial Research.

Advisory Committee on Foods and Drugs.

Advisory Committee on Metropolitan Water Supply.

Oils Committee of the Tender Board.

No meeting was held of the Stock Diseases Committee.

## FIELD INVESTIGATIONS.

In August I visited Kalgoorlie as a Government representative at the annual meeting of the Australian Institute of Mining and Metallurgy. I took the opportunity whilst on the goldfields to become personally acquainted with the important deposits of magnesite at Bulong which are now lying idle. I also investigated the growing felspar industry at Londonderry. This locality is now supplying various Australian markets with felspar (microcline) of the highest quality for use in ceramics and abrasives. Davyhurst and Mulline were also visited to note their resources of lithium minerals.

Whilst on leave in New Zealand I had an opportunity of studying the equipment and administration of the Dominion Laboratory at Wellington.

The pine plantations in the Helena and Darkan valleys were visited with officers of the Forests Department in connection with a research into the relationship existing between soil composition and texture and the healthy or unthrifty condition of various species of exotic pines.

Mr. B. L. Southern, of the Agricultural Section, spent part of his long service leave at the Waite Agricultural Institute, Adelaide, comparing our methods of soil examination with theirs. He also visited Melbourne to draw up in conjunction with Mr. W. R. Jewell (Director Victorian State Laboratories) a standard specification for basic copper compounds to be used as bunticides.

## PUBLICATIONS.

The following technical papers were published by members of the staff:—

H. E. Hill: Chemical Investigation of the Extractives of two West Australian Woods—(1) the oleoresin of *Myoporum seratum*; (2) the oil and colouring matter of the stem of *Acacia acuminata*. Jour. Roy. Soc. of W.A., Vol. XVIII.

A. J. Hoare (with L. J. Teakle and I. Thomas, of the Department of Agriculture): The Value of Manganese as a Fertiliser in Western Australia. Jour. Dept. Agr., W.A. Vol. X.

E. S. Simpson and C. R. Le Mesurier: Minyulite, a new phosphate mineral from Dandaragan. Jour. Roy. Soc. of W.A., Vol. XIX.

R. G. Lapsley: The Enzymes of Cow's Milk. Chem. Eng. and Min. Review, Nov., 1933.

## FOODS.

Samples of bacon, bread, butter, cornflour, fish paste, flour, ham paste, honey, jams, jelly crystals, margarine, meat, sausages, and various condiments were examined for the Health Department, Tender Board and others. Of the 30 official samples collected by health inspectors, 16 complied in every respect with the regulations, 10 were below standard in composition, and 7 failed to comply with conditions regarding labelling. Details will be found in Mr. Malloch's report hereunder.

Consideration was given by the Foods and Drugs Advisory Committee to the regulations dealing with margarine, imitation vinegar and tripe.

The genuine butter trade, which is of the greatest value to the State, is threatened by the appearance on the market of a margarine with a base of hydrogenated cocoanut oil, coloured by palm oil and probably flavoured with diacetyl, which has all the appearance and much of the flavour of genuine butter.

It was discovered during the year that practically the whole of the tripe consumed in the metropolitan area was being bleached and plumped by treatment with sodium peroxide. Such tripe thereafter had a strongly alkaline reaction, and was obviously not suited for use as a food, particularly for invalids. This matter was considered and a new regulation dealing with tripe was drafted in such a way as to prevent the use of sodium peroxide in its preparation.

## MILK.

Seventy bovine milks and 60 human milks were analysed, the latter being submitted by Infant Welfare Clinics and hospitals. The determined composition of the latter helped to shed light on many cases of malnutrition or malaise, some milks being abnormally rich, and others abnormally poor in one or more important constituent.

Of 51 official samples of bovine milk, 39 complied with the regulations in regard to chemical composition and freezing point.

## BEVERAGES.

The Liquor Inspection Branch submitted 5 samples of whisky, 7 of beer and stout, and one of wine. Of these 8 were true to label and in accordance with regulations in respect of spirit strength and preservatives.

Only five samples of "soft drinks" were examined. Three of these, however, brought out an important fact, as it was proved that long contact of such acidulous drinks with a copper vessel during manufacture had resulted in sufficient copper going into solution to cause severe vomiting when the bottled beverage was drunk even in small quantities.

## TOXICOLOGY.

Again all records have been broken under this heading, no less than 189 specimens being examined for the presence of poisons. This is in part due to the totally unnecessary numbers of specimens sent in by some physicians in connection with a single case. If a person has died from, say, strychnine poisoning, it should not be necessary to send in six or seven separate exhibits to establish that fact. Again if a person was obviously killed by a

bullet through the brain, it seems a waste of time and money to examine a number of specimens of viscera for all the common groups of poisons, yet this is what we are not infrequently asked to do.

Mr. Malloch has dealt, in his report hereunder, with several outstanding cases. One death occurred through the ignorant use of sodium fluoride in place of sodium bicarbonate. As the former poisonous substance is widely used nowadays for destroying insects, I have recommended that it be put on the list of scheduled poisons (Part II.).

#### METROPOLITAN AND COUNTRY WATER SUPPLIES.

The quality of water supplied to the metropolitan area is closely watched both chemically and bacterially by the Advisory Committee of which I am a member. It is regrettable that for financial reasons treatment with lime has had to be discontinued. Treatment of all risky sources with free chlorine however, continues, and regular bacterial tests indicate the satisfactory degree of sterilisation thus effected.

One or two troubles of purely local incidence have been investigated. In one case, crude tar instead of boiled tar, had been used in making the bitumen mixture for lining pipes. The result was that clots of soft tar-bitumen mixture broke away and passed through house taps during spells of hot weather. In other instances the new system of lining pipes with cement concrete was found to have raised the pH of the water to an undesirable degree of alkalinity.

The recent extension of the Mundaring water supply from Kalgoorlie to Ora Banda was done with reinforced cement pipes. As the main is over 40 miles long, the effect of the cement increasing the alkalinity of the water was most marked, the first water passing out of the main being totally unfit for human consumption, having a caustic alkalinity almost equal to 3,000 parts NaOH per million. As only the surface layer of the cement will be concerned in this action, the trouble should right itself in a short time. By the first week of January, 1934, it had already dropped to 235 parts per million.

Farmers in large numbers continue to avail themselves of the cheap opportunities of having water analysed from new drill holes or rapidly evaporating pools and dams. The standards for stock waters established in 1926 continue to be used with satisfaction.

#### PRODUCER GAS FROM THE GOLDFIELDS TIMBERS.

In view of the low power costs of the Gwalia Gold Mine Co., at Leonora, using producer gas obtained from local mulga timber, the State Mining Engineer had a number of trial runs on various timbers carried out at the Kalgoorlie State Battery. The original timbers and resulting producer gases were submitted to us for analysis and determination of calorific value. The latter figure ranged from 8154 B.T.U. gross per pound for blackbutt (*Euc. oleosa*) to 8816 for mulga (*Acacia spp.*). Gimlet (*Euc. salubris*) gave the gas possessing the highest calorific value, viz. 135 B.T.U. gross per cubic foot.

#### SOILS.

The demand for chemical and mechanical analyses of soils has developed enormously during the last few years, as shown by the following figures of samples submitted:—

1929.	1930.	1931.	1932.	1933.
102	200	503	503	1139

Of these 724 were samples collected by the Department of Agriculture either in connection with soil surveys in the Salmon Gums and other districts, or in connection with a seasonal survey of soil nitrate in orchard land in the South-West. The latter results are being published in the Journal of the Department of Agriculture of W.A.

The Forests Department have had no less than 328 soils examined, mainly in connection with a study of the growth of various exotic conifers in their pine plantations. As the trees are in poor condition in certain patches of these plantations, it is desirable to know what types of soil will insure rapid and healthy growth of timber.

#### FERTILISERS.

The results obtained from analyses of commercial fertilisers this year were not as satisfactory as in the previous few years. This year 19 out of 54 samples did not comply with the regulations. The faulty samples were mostly "Blood and Bone." The most important fertiliser in use, viz., "Superphosphate," was of good quality in every instance.

#### STOCK DISEASES ACCOMPANIED BY ANAEMIA.

The successful use in New Zealand and Kenya of licks containing finely pulverised limonite as a cure for bush sickness and related diseases, led me some years ago to recommend its use in combating similar diseases here. The State contains many deposits of limonite of suitable quality for this purpose, viz. low in siliceous grit and rich in easily dissolved iron hydroxide, besides containing those traces of manganese and copper, without which the administration of iron appears to be ineffective.

#### FUNGICIDES.

Mr. B. L. Southern, of this Branch, has devoted a great deal of time to the study of copper bunticides. For this reason he was authorised by an interstate conference of Ministers of Agriculture, to confer with Mr. W. R. Jewell of Victoria, and draw up a draft regulation covering specifications for basic copper compounds put on the market as fungicides. This has been done, and the regulation (see below page 67) has been gazetted in this State, where it is now operative.

#### WHEAT AND WHEAT PRODUCTS.

Through the co-operation of the other States, it was again possible to compare the figures obtained by a single cereal chemist (Mr. R. G. Lapsley) on the standard commercial f.a.q. samples of our most important grain from the four chief producing States. The figures will be found in Mr. Hoare's report hereunder. This year there was remarkably little difference between the whole four.

Half of the remaining 157 wheat samples dealt with were taken from trial plots on the State Ex-

perimental Farms, the results being required in connection with breeding and fertilising trials. A further 74 samples were examined for the Royal Agricultural Society in connection with their annual competitions.

Of the flours analysed, thirteen were examined with a view to the establishment of a standard for export flour.

Those by-products of flour milling, bran and pollard, which are largely used as fodders by dairymen and poultry farmers, are standardised locally as to quality by regulations under the Feeding Stuffs Act. Of 30 samples collected officially, not one complied with the regulations in every detail. One case only, however, appeared to be a serious case of adulteration.

#### PROSPECTING FOR GOLD.

This Branch is naturally closely in touch with prospectors, large numbers of whom submit ore samples for assay, or minerals for determination, and report on their present economic value. Our records give ample evidence of the renewed activity in this direction, partly owing to the high price of gold, which reached a maximum of £7 16s. 0½d. in Australian currency per ounce of fine gold towards the end of December, and partly to the Government's subsidised scheme of assisting unemployed men to become prospectors. Many of these men submitted samples of a payable grade. In addition a large number of cores were submitted for assay by companies who were testing various abandoned or unworked mines by means of diamond drills. Some particulars will be found in Mr. Bowley's report hereunder.

#### MINERAL DETERMINATIONS.

Among the 330 minerals submitted for determination by the public, or collected by officers of the Chemical Branch, several are of more than passing interest.

*Petalite, Londonderry.*—This silicate of lithium and aluminium was found for the first time in Australia by myself when inspecting Seahill's Felspar Quarry at Londonderry. With the next three minerals it is being described in a paper shortly to be published by the Royal Society of W.A.

*Rostevite, Melville.*—A caesium bearing variety of beryl only known previously in Australia at Wodgina. In addition to the rare metal caesium, which is used in radio-telegraphy, it carries notable amounts of rubidium, an important constituent of many luminous paints.

*Native Arsenic, Kalgoorlie.*—A single specimen was found for the first time in the State in Chaffers Gold Mine, Kalgoorlie.

*Palygorskite, Dartmoor.*—An unusual clay mineral found in sinking a well.

*Tantouxenite, Tambourah.*—A very rare titanotantalate of yttrium, found previously at Cooglegong, Eleys, and one or two other localities in the North-west, which is the only part of the world where it is known to occur.

*Helvite, Melville.*—This rare sulphosilicate of beryllium and manganese has been found at two points a little north of the township of Melville.

*Apatite, North of Hill River.*—Specimens of rock carrying phosphatic coprolites were discovered some miles north of the Hill River, indicating a previously unsuspected northward extension of the Cretaceous phosphate and glauconite beds of Gingin and Dandaragan.

#### GLAUCONITE RESOURCES.

Many inquiries were received during the year about the beds of glauconite known to occur in the State. The mineral is a hydrous silicate of potassium, iron and magnesium, which after activation is found to be one of the best materials to use in the "zeolite" system of water softening. The Western Australian deposits, which are of Cretaceous age, consist of almost horizontal beds of "greensand," i.e., a loosely coherent mixture of quartz sand, glauconite and kaolin. These are known to occur over an area about 85 miles by 6 or 7 miles, stretching northward from Gingin to beyond the Hill River. Throughout this area they outcrop round the contours of ridges and valleys, and in places, according to measurements made by the Geological Survey, reach a thickness of 230 feet with a central parting of chalk 20 feet thick. Already a small tonnage has been exported to Victoria and Great Britain, and its quality very favorably commented on.

#### TANTALITE.

Western Australia continues to supply the greater part of the world's demand for this mineral. All export parcels from the State, as well as new prospecting samples, are assayed in this laboratory for tantalum, niobium and tin content. The latter objectionable constituent can be removed almost completely by electromagnetic treatment, but only complete chemical extraction can separate the niobium from ore rich in that so far valueless metal, and correspondingly poor in tantalum.

#### COLLIE COAL.

In connection with the constantly recurring problem of how best to utilise our large resources of subbituminous coal at Collie, a re-examination has been made of typical samples collected from the newest working faces. The results will be found in Mr. Bowley's report hereunder. A number of samples were also analysed from a new find on P.A. 45, lying some distance to the north-east of existing workings.

#### CONCLUSION.

In conclusion I attach the detailed reports on the three sections of the laboratory by their respective heads.

I desire also to express my appreciation of the loyal and efficient conduct of all members of the Staff under the trying circumstances brought about by drastically reduced funds and high pressure of work submitted.

EDWARD S. SIMPSON, D.Sc., B.E., F.A.C.I.,  
Government Mineralogist and Analyst.

## SECTION 1.—TOXICOLOGY, FOODS AND DRUGS.

(By F. J. Malloch, O.B.E., A.A.C.I.,  
A.W.M.C. (Met.) )

During the year a total of 774 samples were examined, compared with 880 samples for last year.

*Toxicology.*—One hundred and eighty nine (189) exhibits were examined as against 176 in 1932, creating a record in this direction. Lysol, strychnine, cyanide, cocaine, and arsenic, were the commonly used poisons. In addition there was one case of poisoning by sodium fluoride, one of caustic alkali, one of mercury, ("white precipitate"), one of methylated spirit, and one of eucalyptus oil.

An unusual case of poisoning, in which the death of a man took place, was due to sodium fluoride, which was taken by him in mistake for sodium bicarbonate. From the stomach and contents I recovered 22 grains of sodium fluoride. In connection with this case, an unlabelled bottle containing approximately 1lb. of white powder was examined and found to consist of 95.4% sodium fluoride. At the inquest the son of the deceased stated that his father used the powder as a foundation for a mixture to kill cockroaches. He had been of the opinion that it was the same as bicarbonate of soda and when the cockroach poison was unsuccessful, he gave the remainder of the powder to his wife for use in the kitchen. She had later taken some and had been ill. She told her husband, who still maintained that it was the same as bicarbonate of soda. On the day of his death he said that he had taken a teaspoonful of the powder to relieve flatulence. Deceased evidently had no knowledge of chemicals, and did not suspect the dangerous properties of the powder handled by him.

Sodium fluoride is used as an antiseptic and insecticide. It is a most irritant and destructive poison, and it would be easy to mistake this compound for the harmless bicarbonate of soda, which it resembles in appearance and taste. The Chief Inspector of Police was notified by letter that sodium fluoride should be placed on the list of scheduled poisons.

In connection with the death of a woman, mercury was recovered from one of the exhibits submitted. It was not possible to determine in what form the mercury was originally present, but as the patient before death stated that she took a white powder purchased in Ceylon to use for hair parasites, this powder would probably be "white precipitate" (mercuric ammonium chloride). This compound is used in pruritus and other skin affections. It is also used in admixture with other ingredients as a cure for ringworm of the scalp.

Another case was that of a man who was shown to have taken a whole bottle of medicine containing chiefly chloral hydrate (240 grains), sodium bromide (320 grains), tinct. camph. co. (320 minims), liquor arsenicalis (48 minims), etc. Death resulted from chloral poisoning.

Another outstanding case was that of caustic alkali poisoning, the man dying from its effect. The stomach contents consisted chiefly of blood, due to the caustic action of the alkali on the blood cells, producing extravasation. This is the first case on record in this State.

Many other unusual and involved toxicological cases have been investigated during the year, and much of my time has been taken up in attending inquests at the Coroner's court.

*Foods and Drugs.*—One hundred and seventy-eight (178) samples were examined for the Health Department compared with 325 samples for 1932. Others were submitted by various other authorities. The most important of these will be commented upon.

*Milk.*—Of 70 samples of milk, including 2 samples of malted milk examined, 50 of these samples were submitted as "official." Of these 38 samples passed the Food and Drug Regulations, and 12 samples were below standard in composition or freezing point. A number of successful prosecutions took place.

The Laboratory possesses a Hortvet cryoscope for the detection of adulteration by water, even when the chemical analysis complies with the regulation. A test case depending on the freezing point of milk as carried out by the Hortvet cryoscope, took place early in this year, in which a metropolitan milk supply company was proceeded against and convicted for selling under-standard milk. The analysis was done by Mr. Hill of this Laboratory, and the prosecution took place on the grounds that 4 samples of pasteurised milk as supplied were not of the nature, substance, and quality of the article demanded in that the freezing point lay between zero centigrade and 0.55 degrees centigrade below zero, thus contravening the Food and Drug Regulations. Although the chemical composition of the milks complied with the regulations, the freezing points were respectively .532°, .528°, .527°, and .525° below zero. The magistrate in giving judgment stated that the cryoscope was generally accepted by chemists as a reliable instrument. There was no question that the company was selling milk that was not up to standard and he was making the penalty as light as possible. A fine of £2 was inflicted, the costs to be agreed on by the parties concerned.

*Human Milks.*—Sixty samples of human milk were analysed for Infant Welfare Clinics and hospitals, compared with 55 samples last year. These samples varied from very poor to abnormally rich in quality. In many cases of infants not thriving or developing sickness, a sample of breast milk has been submitted for analysis. These conditions are dependent amongst other things on the quality of the milk which the infant receives, and for this reason the analyses are undoubtedly of great assistance to the various Infant Welfare Clinics in adjusting the feeding of infants.

*Condensed Skim Milk.*—Only one sample was examined during the year. This sample possessed a light coffee coloured appearance due to caramelising or burning of the milk during its processing. The consistency was also poor, most of the mixture being in a very lumpy condition. On standing, fermentation took place with the production of gas, and the sample possessed a malty odour. Although it might not be unfit for human consumption, both the colour and odour were foreign to that of a fresh preparation, and it was therefore certified that it did not comply with the Food and Drug Regulations.

*Butter.*—Fourteen samples were received, 6 samples being examined for the Health Department, one of which did not comply with the Regulations, and 7 samples for the Superintendent of Dairying, one of which did not comply. One sample for export was examined for a butter company in the South-west of this State.

*Bacon.*—Five samples were examined for the Health Department, 2 of which did not comply with the Regulations, in containing a greater amount of potassium nitrite than that permitted. Owing to the possibility of some of the potassium nitrate originally added, being reduced to potassium nitrite by bacterial or other agencies, it was recommended that enquiry be made as to the nature of the substance which was being used for curing the bacon, with a view to ascertaining whether it contained potassium nitrite. All the samples complied with the Regulation regarding the amount of potassium nitrate present.

*Margarine.*—A sample was examined for the Health Department. It was a firm, palatable margarine derived from cocoanut oil. The colouring matter consisted of carotene, probably added in the form of palm oil. This sample closely resembled butter in colour and taste and might easily be used in restaurants as a substitute for butter, thereby seriously affecting the local butter industry.

*Cream.*—Two samples were examined for the Health Department, one being an official sample which complied with the regulations, the other cream being unofficial, and said to be "made from butter," which did not comply. The sample of cream "made from butter" was found to consist of butter and liquid converted into a homogeneous emulsion resembling cream. The emulsion readily broke up into butter fat and liquid on heating.

*Summer Drinks and Cordials.*—Five samples were examined for the Health Department, 3 samples failing to comply with the Regulations, due to serious contamination with a metallic poison, namely copper. These were analysed as a result of complaints that vomiting had occurred after drinking them.

*Vinegar.*—Sixteen samples were received during the year. Nine official samples were examined for the Health Department, 4 of which did not comply with the general standard for vinegar, whilst 7 failed to comply with the labelling regulations. Six samples were examined for the Government Tender Board, of which 2 failed to comply with the general standard, and 2 failed to comply with the labelling regulations for vinegar. During the year the manufacturers of five different brands of vinegar purchased from city and suburban grocery stores were prosecuted and convicted in the Perth Police Court. The samples did not comply with the Regulations for genuine vinegars, and were also incorrectly labelled. In each case the manufacturers pleaded guilty, and fines amounting to £19 5s. 0d. were inflicted. The Foods Advisory Committee is at present considering the drastic amendment of the present vinegar regulations with a view to protecting the public from purchasing imitation vinegars that are placed on the market as genuine.

*Honey.*—Eight samples were examined for the Government Apiculturist, all of which complied with the Regulations.

*Tripe.*—Six samples were received during the year, 2 from the Health Department, and 4 from the Midland Junction abattoirs. The 2 samples submitted by the Health Department were examined with reference to a complaint that when cooked with onions, the tripe turned them green. The samples of tripe were somewhat disintegrated, strongly alkaline, and when macerated with water gave a pH of 10, showing the presence of caustic soda and sodium carbonate. It is evident that the tripes had been treated in a bath of some strongly alkaline liquid which had been incompletely washed out, and the supplier confessed to the use of sodium peroxide. Tripe which had been so treated was reported as unfit for human consumption. Six samples of the liquor used by the wholesale supplier were examined with a view to ascertaining the bleaching agent used by him in tripe preparation. The solutions were all strongly alkaline, with the exception of one which was evidently a wash water. The analyses showed that the tripe was being treated in a bath of weak "sodium peroxide" solution with probably some sodium carbonate, with a view to bleaching and "plumping" it. The small amount of caustic soda alkalinity found in 3 of the liquors was probably derived from the sodium peroxide, which decomposes in water to form caustic soda and hydrogen peroxide. In this treatment the fibres of the tripe become disintegrated and swollen, resulting in a condition known as "plumping." It is said that a considerable increase in weight takes place, 20 lbs. of tripe before treatment producing at least 25 lbs. after treatment. This process of bleaching may seriously affect the nutrient value of a foodstuff which is used chiefly for invalids, and in my opinion, the process should be prohibited. The use of hydrogen peroxide would be preferable, as no caustic alkali or sodium carbonate would be present in the resultant liquor, as is the case when sodium peroxide is used.

Further investigations showed that fresh, untreated tripe was practically neutral, and slowly became acid, whilst the peroxide bleached tripe was alkaline and became more so with lapse of time.

*Drugs and Medicine.*—Fourteen samples were examined during the year, 9 for the Health Department, and 5 for the Medical Board.

In connection with the latter, consisting of four bottles of pills and one bottle of "Af Gha Tonic" remedy, the Board proceeded against W. J. Taylor for being a person other than a medical practitioner holding himself out as able or willing to give medical advice or service contrary to the Medical Act. He was convicted on 2 charges, and a fine of £20 on each charge with £14 17s. 0d. costs was inflicted.

Two of the bottles of pills were prescribed for "palpitation of the heart." and 2 bottles of pills for a "weak spine." The pills were examined by me and found to be wholly of an herbaceous character, resembling the harmless drug "Buchu" in appearance, smell, microscopical examination and chemical tests. The pills prescribed for "heart palpitation" were similar to those prescribed for a "weak spine."

The "Af Gha Tonic" remedy, prescribed also for palpitation of the heart, was found, on analysis, to

consist of a wine containing meat extract with a little lime and phosphoric oxide (similar to *Wincarnis*). The alcoholic strength was 25.92% proof spirit. A physician, in evidence for the prosecution, stated that in some cases of palpitation of the heart, this tonic wine might be dangerous.

*Tender Board Samples.*—One hundred and eighty four (184) samples were received from the Tender Board as against 197 for last year. They comprised chiefly oils, soaps, soap mixtures, jelly crystals, jams, starches, cornflours, self-raising flours, table salts, essences, sauces, chutneys, cream of tartar, baking powders, vinegars, pickles, fly sprays, insecticides, laundry blue, ink, metal polishes and floor polishes. The results of analyses were used as a guide in accepting tenders for supplies for Government institutions.

*Oils.*—Thirty-nine samples were examined, chiefly for the Tender Board. One interesting sample of oil (emulsified) was taken from the sump of the police Bentley motor car in which it had caused the burning out of the big ends of the engine. It consisted of a stiff emulsion of oil and 2% water, which was probably stabilised by the nature of the special racing oil used, which contained 2.9% oleic acid. The emulsion was due to admission of water to the sump, and the churning of the oil and water by the engine running at high speed. When using a special high speed motor oil which contains oleic acid, any access of water into the sump should be guarded against.

*Bitumens.*—Six samples were examined for the Main Roads Board for specific gravity, solubility in carbon bisulphide, and solubility in carbon tetrachloride. One sample was examined for the Government Tender Board for specific gravity, softening point, flash point, solubility in carbon tetrachloride and solubility in carbon bisulphide. The samples complied with specifications.

*Investigation of Fuels used for Mining Purposes.*—As the local fuels, namely coal and timber, are being displaced by imported fuel oils, a series of investigations were made into the properties of the local fuels and their suitability for generating power for use on the mines.

For this purpose 7 different timbers supplied by the Goldfields Firewood Co. to the Kalgoorlie mines were tested practically in 10-ton lots in a gas producer by the State Batteries Branch. Samples of the timber and gas produced in each instance were examined in this Laboratory by Mr. Hood, who was engaged on this important work for a considerable time during the year. The investigation required the determination of moisture content, air-dried moisture, ash, calorific value (dry basis) and calorific value calculated to mean original moisture. The firewoods examined were mulga, salmon gum, gimlet, blackbutt, redwood, and white gum. The result of the examination showed that the amount of original moisture governs to a large extent the calorific value of the firewoods. Calorific values calculated to a common dry basis disclosed no outstanding variations between different species of wood with the exception of mulga, which gave the highest calorific value in both the samples sent at different times. Mulga received on 21/4/33 had

a calorific value of 8816 B.Th.U. gross, and mulga received on 29/8/33 had a calorific value of 8790 B.Th.U. gross, whilst the lowest in the series of 7 firewoods was blackbutt with a calorific value of 8154 B.Th.U. gross.

Of the 6 samples of producer gas derived from the above types of firewood, and forwarded from the State Battery at Kalgoorlie, the high oxygen and nitrogen content of the gas from mulga showed that contamination by air had taken place, thus seriously affecting the calorific value of the gas. Apart from this, the producer gas from gimlet gave the highest calorific value, *i.e.*, 135 B.Th.U. gross, and the lowest calorific value from blackbutt 116, and white gum 116.

*Explosives and Cattle Dips.*—Twenty-two samples of explosives were examined for the Mines Department, and 24 cattle dips for the Agricultural Department. The strength required for cattle dips is 0.2%  $\text{As}_2\text{O}_3$ , and no sample diverged more than 0.02% from this standard.

*Liquor Inspection Branch, Police Department.*—Five samples of whisky were examined, two of which were found to be genuine, one adulterated with water, and one was fictitiously labelled. The fifth was examined for standard purposes. The whisky submitted for false trade description was labelled "King George IV. Scotch Whisky," but it was found that this sample did not comply with the chemical analysis and colour index of a standard sample of the same brand and operation. This case was heard in the Northampton Police Court, the vendor, who pleaded guilty, being fined £5 with £6 6s. costs.

Five samples of beer, 2 samples of stout, and one sample of wine were also examined for the Liquor Inspection Branch. Two of the samples of beer and one sample of stout failed to comply with the Food and Drug Regulations.

*Organisation.*—The year was saddened by the death of Mr. C. E. Stacy, late Assistant Government Analyst and Toxicologist, who was associated with the Department for 34 years.

I desire to express my appreciation of the whole-hearted co-operation which the officers of the Section have shown, and the efficient manner in which they have carried out their work during the last six months of the year in which I have been supervising the Foods, Drugs, and Toxicological Section.

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## SECTION II. — MINERALOGY, MINERAL TECHNOLOGY, AND GEOCHEMISTRY.

By H. Bowley, F.A.C.I.

During the year two thousand eight hundred and sixty-four samples were entered for examination by this section. Although these figures show a slight decrease on those for the previous year, the samples classified as "public pay" and "public free" exceeded those received during 1932 by 815 and 74 respectively, with a consequent considerable increase in fees received.



Samples of coal received from three different seams on P.A. 45, Collie, gave the following figures on analysis:—

1. 10ft. 2in. seam in shaft. Depth to top, 37 feet.
2. 7ft. seam.
3. 8ft. seam separated by 19 inches of shale. A top, B bottom.

*Proximate Analysis.*

—	1.	2.	3.	
			A.	B.
	%	%	%	%
Moisture ...	24.76	14.90	14.79	15.92
Volatile hydrocarbons	23.51	26.70	31.77	27.60
Fixed carbon ...	45.33	51.45	46.30	50.40
Ash ...	6.40	6.95	7.14	6.08
	100.00	100.00	100.00	100.00
Ratio F.C. to V.H.C.	1.93	1.93	1.46	1.83
<i>Calorific Value—</i>				
B.T.U. (By bomb calorimeter):				
Original moist coal	8,906	10,176	...	10,360
Ash and moisture-free coal ...	12,937	13,021	...	13,282

*Talc.*—A sample of talc of good commercial quality was received from Dandaragan Station near Sandstone. It yielded a fine white powder entirely free from gritty particles.

*Clays.*—Of the clays examined to determine their suitability for ceramic purposes, the following are of special interest:—

Colour and Type.	Clay Substance + Grit under 90-mesh.	Ashley Plasticity Figure.	Colour on burning at 1150°C.	Incipient Vitrification.
1. White, Semi-ball ...	99.1	50	Good white	1050°C.
2. Grey, Fullers Earth ...	97.4	243	Cinnamon	1000°C.
3. White, Ball ...	92.6	92	White ...	1050°C.
4. Creamy-white, Semi-ball	96.1	53	Good white	1150°C.
5. Greyish-white, Fireclay	97.1	35	Good white	1350°C.

*Locality.*—1, Murchison River; 2, Bassendean; 3, Capereup; 4, Armadale; 5, Collie.

After the removal of the grit in 3 by careful washing, the refined product is suitable for use as a filler in the manufacture of paper.

*Building Materials.*—The surfacing materials used in the manufacture of some local cement roofing tiles were examined to determine whether they contained any compounds likely to have an injurious effect on the men handling them. In all cases they consisted of cement with an inert filler and pigments.

*Glaucanite.*—Glaucanite occurs in enormous quantities at each end of the coastal area extending from Quindalup, south of Perth, to the Hill River, 125 miles north of Perth. The most important deposits appear at present to be in the Gingin-Dandaragan area.

*Beryl.*—The rare caesium bearing beryl, roosterite, appears to be widely distributed in this State, specimens being received from Lewis and Houston's Rock-hole M.L., and M.L. 86 in the Wodgina District, also from Harrison's Reward M.L. at Melville. An an-

alysis of the Melville mineral gave:—SiO<sub>2</sub>, 64.59 per cent.; BeO, 11.31 per cent.; MnO, trace; Li<sub>2</sub>O, .16 per cent.; Na<sub>2</sub>O, .28 per cent.; K<sub>2</sub>O, trace; Cs<sub>2</sub>O, 1.80 per cent.; Rb<sub>2</sub>O, 1.40 per cent.; H<sub>2</sub>O + 1.21 per cent.; H<sub>2</sub>O—, .08 per cent.; Al<sub>2</sub>O<sub>3</sub>, 19.08 per cent.; Fe<sub>2</sub>O<sub>3</sub>, .14 per cent.; MgO, nil; CaO, nil; Total, 100.05; G, 2.743; Ng, 1.584; Np, 1.5785. Analyst. D. G. Murray.

A bulk sample, weighing 6 lbs. avoirdupois, of common beryl from Melville was found to contain 13.5 per cent. BeO.

Beryl was also recorded from Location 3445 at Yabberup and Bloek 104, Katterup, both in the South-West Division of the State.

*Gadolinite* (silicate of beryllium, yttrium and iron).—Specimens of this mineral were received from the Fibre Queen Asbestos Claim, via Abydos Station, in the Pilbara Goldfield. Greenish black gadolinite with a brownish coating of the decomposition product known as Metagadolinite, was also recorded from 20 miles south-east of Wodgina, a locality possibly identical with Abydos Station.

*Scheelite* (tungstate of lime).—Scheelite was recognised in small quantities in a gold ore from P.A. 2380, Clampton, Yilgarn Goldfield.

*Tantexenite* (titano-tantalate and niobate of yttrium, etc.) mixed with cassiterite and monazite was received from 20 miles south of Wodgina. Specimens of crystallised tantexenite were also received from six miles north of Tambourah.

*Struverite* (titano-tantalate of iron).—Small fragments of this very rare mineral associated with limonite and quartz were present in a sample from near Bridgetown Location 11472. This is the first recorded occurrence of this mineral in Australia.

*Mineral Analyses.*—Complete chemical analyses have been made of the following:—

(a) *Minerals.*—Actinolite, Lake Goongarrie; Antimony ochre, Wiluna; Biotite, Holleton and Ubini; Blende, Mundijong, Payne's Find; Chlorite, Holleton; Coprolite, Gantheaume Bay; Diopside, Chittering Brook; Gigantolite, Melville; Microcline, Wodgina; Miloschite, Meekatharra; Palygorskite, Wandalong; Petalite, Londonderry; Pseudomorph after petalite, Londonderry; Rosterite, Melville.

(b) *Ores.*—Gold ore, Wiluna.

### SECTION III.—AGRICULTURE, WATER SUPPLY AND SEWERAGE.

By A. J. Hoare, A.A.C.I.

The total number of samples entered for the year 1933 was 2,059, an increase of 266 over the previous year; the sources of the samples will be found on page 58.

*Staff.*—Owing to the large amount of soil work required by the Forests Department arrangements were made with that Department to make available a certain amount of money to cover the expenses of a chemist and extra apparatus. Miss H. T. Cole, B.Sc., a graduate of the West Australian University, was appointed to the position on the 3rd July, 1933.



Mr. B. L. Southern spent portion of his long service leave at the Waite Institute, South Australia, studying the methods of soil analysis as conducted there. It was found that the West Australian methods are well up to date, but that we could do with more apparatus.

*Soils.*—The number received (1,139) was more than double those received last year. Of these, 724 were submitted by the Department of Agriculture. A nitrate survey of soils from an apple orchard situated at Argyle accounted for 531. This work was to continue for twelve months, and will be finalised in January, 1934. The conclusions drawn will be published by the Department of Agriculture in their journal about June, 1934. The soils were taken from orchard, pasture and fallow land, artificial fertilisers being added during the season. The balance of the soils from the Agricultural Department were principally check samples taken during soil surveys and were analysed principally for water soluble salts, sodium chloride and reaction (pH). Typical samples were picked out for more detailed work such as mechanical and chemical analyses and composition of the water soluble salts. It is hoped to do further work on the typical soils of Western Australia at a later date and publish the results.

The Forests Department submitted 328 soils during the year, 159 being taken from their different pine plantations. The mechanical analysis of all of these was required, as well as the chemical analysis of the first and, in most cases, the second depth samples. Under a settlement scheme the same Department sent in 97 samples to be treated in the same way as the pine plantation soils. There is a yellowing off of pines at certain times of the year and this was thought to be due to lack of nitrates in the soil, so it was decided to forward samples for nitrate estimation from the Myalup plantation about every six weeks to be taken from where the pines are healthy (green), as well as from where they were showing yellowing and from fallow land. This work was started in September and is to continue for twelve months.

A sample of soil submitted by the W.A. Cricket Association was obtained from Harvey and is used for the preparation of turf wickets. It is said to crack and crumble when dry, and will not allow the grass roots to penetrate below two or three inches. The soil is a heavy black clay, the clay fraction being very high (79.5 per cent.), and the fine sand and silt figures very low (7.7 per cent and 8.8 per cent) when compared with soils used in the Eastern States of Australia for turf wickets. The absorption (Ashley figure) was 502. The soil had a pH of 5.98.

*Fertilisers.*—Fifty-four official samples were submitted by the Inspector of Fertilisers during the year, nineteen of which did not comply with the regulations, being below the guarantee in one of the constituents. The balance of the samples (16) were from private sources.

*Fungicides and Insecticides.*—Only four samples were received for investigation before registration. The other seven received were tobacco leaves and stalks grown at Pemberton in Western Australia for nicotine estimation: this ranged from a trace to 2.67 per cent.

During Mr. Southern's visit to the Eastern States he conferred with Mr. Jewell, Director of Victorian State Laboratories, in order to fix and recommend for adoption by all the States standards for copper carbonate bunticides. The standards recommended by them have been gazetted under the Plant Diseases Act, 1914, by this State and are as follows:—

- (a) It shall contain not less than 50 per cent. copper (Cu) in the form of basic carbonate and/or basic sulphate or oxychloride; and the label upon the container in which the material or mixture is contained shall state, in addition to the percentage of copper, the form or forms of basic salt in which it occurs;
- (b) It shall contain not more than one-quarter per centum of copper in a form soluble in water;
- (c) Not more than two-and-one-half per centum of the material shall be retained on a standard I.M.M. 200-mesh sieve, when ten grams of the material are shaken by hand for five minutes with 150 cc. of water in a stoppered 500 ccs. Erlenmeyer flask and sieved in a gentle stream of water poured from the flask or a wash bottle.

*Fodders.*—Very few fodder samples were received during the year, only seven in all.

In connection with the canning of crayfish (*Tanulirus penaeillatus*) at Geraldton, it has been suggested that the waste from the factory would make a good poultry meal. A sample was forwarded for analysis, with the following results:—

Lab. No.	... 4248
	%
Moisture at 100°C.	... 5.39
Petroleum ether extract	7.45
Sodium chloride (calculated from chlorine) ...	2.56
Nitrogen (total) ...	7.13
"    in chitin ...	.34 = Chitin 5.66 %
"    in muscle, etc....	6.79 = Protein 42.43 %
Phosphoric oxide, P <sub>2</sub> O <sub>5</sub> ...	6.65
Iodine ...	Present

This would make a very useful fertiliser, and is well worth experimenting with as a rich protein concentrate for poultry.

*Waters.*—The number of samples received during the year was 547, of which the Metropolitan Water Supply Department submitted 313, principally for partial analyses including the determination of iron. Every quarter samples were submitted to hygienic analysis and the quality of the water supplied from the different sources was found to be consistently good. The reaction of the water after passing through cement-lined mains is for a time as high as pH 9.6, the original pH being about 6.5-6.7 during the winter months, and 8.0-8.3 during the summer, when portion of the supply is drawn from deep bores. In connection with the cement lining of iron mains three samples of the lining were submitted for analysis taken from a test length that was to be connected up to the main. This will be tested again

after water has been flowing through for some months. The following figures were obtained:—

Lab. No. ...	3919.	3920.	3921.
Description.	First 1/16-in. cut from pipe centre.	Middle 1/8-in. cut.	Last 1/8-in. cut next to iron.
	%	%	%
Siliceous insoluble (rock, sand, etc.) ...	9.79	47.66	62.50
Combined silica (derived from cement) ...	18.55	11.64	8.37
Lime (acid soluble) ...	50.85	29.87	21.97
Magnesia (acid soluble)	.95	.68	.46

The Department of Works and Labour submitted 85 samples taken from the Mundaring reservoir, Kalgoorlie reticulation and country towns water supplies. Taking West Australian standards these are all of good potable quality.

Stock and irrigation waters submitted during the year totalled 115, and as is always the case a few were too saline to be used for any purpose.

*Sewage.*—Samples were received from the treatment works at Perth, Subiaco and Fremantle to the number of 44. The tanks and filter beds appear to be working satisfactorily.

#### *Mineral Deficiency Diseases in Stock.*

*Denmark.*—The only work done on material from this district was the conclusion of analyses of ten soils left over from the previous year.

*Gingin.*—With the exception of two samples of water for chemical analysis and estimation of lead, no further samples were received. It was found that the water from Gingin Brook contained 0.02 parts per million of lead; lambs on country watered by this brook develop ataxia. On the other hand, animals on Mungala Brook remain sound and no lead was found in the water from it.

*Brans and Pollards.*—Of the 30 samples received, eighteen were official samples taken under the Feeding Stuffs Act. These all failed in some respect to comply with the standards set down under the regulations for moisture, fibre, ash and fineness. One sample of bran contained approximately 10 per cent. of foreign matter.

*Flour.*—Of the 32 samples received, seven were from commercial flour mills for examination as to strength, gluten (wet and dry), moisture and protein. The balance were flours obtained in the grinding of wheat samples received from the Agricultural Department; these were tested principally for the maltose figure as set down by Dr. Kent Jones, England, this ranged from 1.03 per cent. to 1.83 per cent. In addition to the above samples, thirteen flours were sent in by the Department of Agriculture in connection with the establishment of a suit-

able standard for West Australian export flour, and 125 flours resulting from laboratory milling of wheat were analysed.

*Wheat.*—Only 161 samples were received during the year, of these 71 were taken from trial plots at Merredin and Chapman State Farms, four f.a.q. wheats, twelve from Dartmoor for the Government Analyst, and four from a private firm. The milling of the wheats and analyses of the flours were carried out on all samples with the exception of the last four.

The figures obtained for the f.a.q. samples are as follow:—

Lab. No. ...	1267.	1268.	1269.	1270.
State ...	New South Wales.	Victoria.	South Aus- tralia.	Western Aus- tralia.
<b>Bushel Weight :</b>				
Declared (lbs.) ...	61 $\frac{3}{4}$	62	60	62
Original " ...	62 $\frac{3}{4}$	61 $\frac{1}{4}$	61 $\frac{1}{2}$	63
Cleaned " ...	62 $\frac{3}{4}$	61 $\frac{5}{8}$	61 $\frac{7}{8}$	63 $\frac{3}{8}$
Moisture (per cent.)...	11.00	11.06	10.97	10.51
Weight in grams of 1000 grains ...	44.66	39.89	38.05	38.80
Wheat protein (per cent.) ...	9.92	9.57	9.80	9.92
Wheat ash (per cent.)	1.49	1.52	1.48	1.70
<b>Products :</b>				
Flour (per cent.)...	71.0	71.7	71.4	71.0
Bran (per cent.) ...	19.6	19.3	19.5	19.6
Pollard (per cent.)	9.4	9.0	9.1	9.4
<b>Flour :</b>				
Moisture (per cent.)	14.09	14.29	14.33	12.76
Strength (per cent.)	53.75	53.25	53.00	53.00
Protein (per cent.)	8.61	8.21	8.21	8.78
Ash (per cent.) ...	0.74	0.60	0.63	0.56
Gluten (wet) (per c't.)	24.20	24.49	25.61	24.88
Gluten (dry) (per c't)	9.50	9.48	9.92	9.90
Hydrated maltose (approx. figure)	0.93	1.23	1.13	1.49
Colour ...	Excel- lent	Excel- lent	Excel- lent	Excel- lent

*Royal Agricultural Society Exhibits.*—The number of wheats received under this heading was 74, of which 46 were selected for milling purposes, after a preliminary culling on the basis of the general appearance of the grain, bushel weight and purity of type or variety. After milling, the flour obtained is analysed, and points are awarded for flour yield, strength, flour protein and colour: these taken in conjunction with the calculated yield of pounds of bread per ton of wheat form the basis for the awarding of the various prizes. The champion wheat this year was a very good sample of Comeback, grown at Bowgada, the total number of marks gained being 91.7.

The milling investigations, with the exception of the protein estimations, 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 for the Peerless Flour Milling Company.

## DIVISION VIII.

# Report of the Chief Inspector of Explosives for the Year 1933.

*The Under Secretary for Mines.*

I have the honour to submit, for the information of the Hon. Minister for Mines, in compliance with Section 45 of "The Explosives Act, 1895," my report on the working of the Branch for the year 1933.

The importations of explosives again show an increase over those of the previous year. There were ten shipments received, and samples from each of these were submitted to the official tests, and in every case, with the exception of one consignment of fire-works, passed the tests satisfactorily. Samples also from each consignment of explosives containing nitroglycerine were submitted to the D'Autriche velocity of detonation test, and showed very satisfactory figures. There was one consignment of fire-works the composition of which, on submitting to analysis, was found to obtain a mixture which is prohibited under the Authorised List, with the result that 22 cases were detained, and finally arrange-

ments were made to ship them back to the manufacturers in China.

Table No. 1 shows the quantities of the various explosives imported into the State during the year:—

TABLE NO. 1.

*Importations of Explosives into Western Australia during 1933.*

Explosive.	Quantity in lbs.
Gelignite ... ..	1,125,700
Gelatine Dynamite ... ..	797,950
Blasting Gelatine ... ..	314,350
Permitted Explosives ... ..	49,750
Powder—Blasting and Pellet ... ..	127,500
Total ... ..	2,415,250
Detonators (No.) ... ..	3,310,000
Fuse (Yards) ... ..	3,770,400

Table No. II. gives a comparison of explosives imported into Western Australia during the past five years:—

TABLE II.

*Comparison of Explosives Imported into Western Australia during the past five years.*

Explosive.	1929.	1930.	1931.	1932.	1933.
	lbs.	lbs.	lbs.	lbs.	lbs.
Gelignite ... ..	337,000	413,500	565,500	1,067,250	1,125,700
Gelatine Dynamite ... ..	405,000	447,000	575,250	617,200	797,950
Blasting Gelatine ... ..	233,500	220,000	145,150	336,600	314,350
Permitted Explosives ... ..	47,500	61,000	20,000	38,050	49,750
Powder—Blasting and Pellet ... ..	207,500	150,000	90,725	136,875	127,500
Totals ... ..	1,230,500	1,291,500	1,396,625	2,194,975	2,415,250
Detonators (No.) ... ..	975,000	1,075,000	1,805,000	2,370,000	3,310,000
	Coils.	Coils.	Yards.	Yards.	Yards.
Fuse ... ..	213,000	232,000	1,987,200	2,880,000	3,770,400

In Table No. III. particulars are given showing the distribution of explosives in the different classes of industry.

TABLE III.

*Distribution and Consumption of Explosives for Years 1932 and 1933.*

	1932.		1933.	
	Lbs. used.	Percentage of total.	Lbs. used.	Percentage of total.
Gold Mining ... ..	1,767,200	91.16	2,140,050	90.4
Agricultural and land clearing ... ..	30,600	1.58	23,600	1.0
Government Departments, including Railways, Public Works, and Water Supplies ... ..	73,300	3.78	108,150	5.0
Quarrying ... ..	44,100	2.28	61,300	2.5
Coal Mining ... ..	23,300	1.20	35,600	1.1

Table No. IV. gives particulars of the Licenses issued for the storage and sale of explosives:—

TABLE IV.  
*Licenses issued during 1933.*

For magazines on Government Reserves ... ..	45
„ „ used by Government Departments ... ..	33
„ „ erected on private property ... ..	43
Store Licenses...	
Mode (a) ... ..	99
Mode (b) ... ..	2
Fireworks only ... ..	212
Importation Licenses ... ..	2

Inspection of licensed magazines and stores have been made where possible, but it was found difficult to carry out the desirable and necessary inspections

throughout the country districts owing to the increased work demanding the attention of the officers of the Department in Perth. It is hoped that in future a greater number and more consistent inspections will be possible as approval has been obtained to use a motor car in connection with the travelling. This will naturally mean an enormous saving in time and thus enable a more efficient inspection of explosives and licensed premises in country districts to be exercised. As a result of the inspections made it was not found necessary to institute proceedings for breaches of the Explosives Act or Regulations, but explosives, as shown in Table V., were found to be in a condition which rendered them unfit for use, and were accordingly destroyed.

TABLE V.  
*Destruction of Explosives during 1933.*

Date.	Place.	Kind and Quantity.	Remarks.
25-1-33	Fremantle ... ..	5lbs. Gelignite ... ..	Absorption of moist re.
13-5-33	Quairading ... ..	2lbs. Gelignite ... ..	do. do.
14-5-33	York ... ..	100 detonators ... ..	do. do.
20-5-33	Wickepin ... ..	2lbs. Gelignite ... ..	Excudation and chemical deterioration.
25-5-33	Kellerberrin ... ..	1lb. Gelignite ... ..	Chemical deterioration.
4-9-33	Kalgoorlie ... ..	50lbs. Gel. Dynamite, 8lbs. Bl. Gelatine, 70lbs. Gelignite 60%, 40lbs. Gelignite 40%, 50lbs. Monobel, 500 Electric Detonators	do. do.
9-8-33	Moora ... ..	3lbs. Gelignite ... ..	do. do.
14-8-33	Geraldton ... ..	7lbs. Gelignite ... ..	do. do.
12-8-33	Three Springs ... ..	7 Coils Fuse ... ..	Damaged by water.
10-8-33	Carnamah ... ..	3lbs. Gelignite ... ..	Chemical deterioration.
14-11-33	Bridgetown ... ..	13lbs. Gelignite, 600 detonators ... ..	do. do.
15-11-33	Greenbushes ... ..	10lbs. Gelignite ... ..	do. do.
17-11-33	Boyup Brook ... ..	10lbs. Gelignite ... ..	do. do.
20-11-33	Bunbury ... ..	11bs. Gelignite ... ..	do. do.
22-11-33	Harvey ... ..	10lbs. Gelignite ... ..	do. do.
23-11-33	Mornington ... ..	40lbs. Gelignite ... ..	do. do.

Tests, as shown in Table No. VI., were made with a view to determining the chemical purity and stability of explosives imported into the State. The large increase in the number of fuse tests over that of last year, is due to a number of reports that were received indicating that accidents had taken place due to fuses running or burning quickly. None of the tests made on the samples taken, however, indicated any irregularity in the burning speed of the fuse which would support the possibility that fuses were being imported which burned at a speed outside that given in the Regulations under the Mines Regulation Act, *viz.*, from 80 to 100 seconds per yard, but a very careful check is being kept of all importations of fuse into the State.

TABLE VI.  
*Tests and Analyses made during 1933.*

Heat Tests ... ..	997
Analyses of Explosives ... ..	22
Fuse Tests ... ..	603
Fireworks Tests ... ..	64
Velocity of Detonation ... ..	97
A.D.C. Tests ... ..	10
Detonator Tests ... ..	40
Miscellaneous ... ..	27

There were no new explosives added to the Authorised List during the year.

J. W. KIRTON,  
Chief Inspector of Explosives.

13th April, 1934.