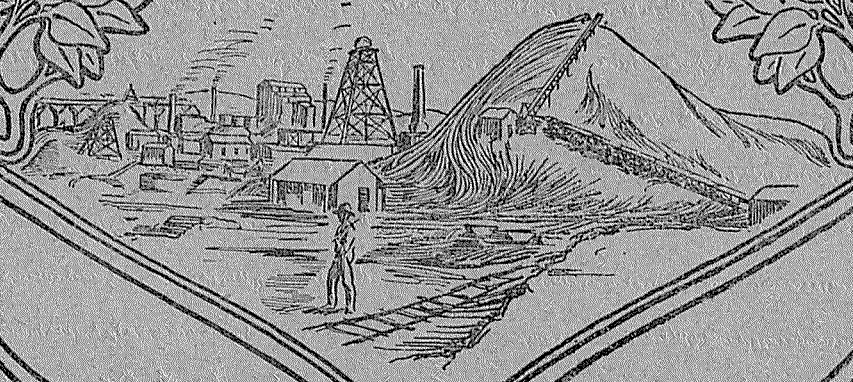
REPORT
OF THE
DEPARTMENT OF MINES
FOR THE YEAR
WESTERN · 1932. · AUSTRALIA



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

1933.

WESTERN AUSTRALIA.

REPORT

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DEPARTMENT OF MINES

FOR THE YEAR

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[FIRST SESSION OF THE FIFTEENTH PARLIAMENT.]

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ANNUAL REPORT OF THE DEPARTMENT OF MINES, WESTERN AUSTRALIA, 1932.

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STATE OF WESTERN AUSTRALIA.

Report of the Department of Mines for the State of Western Australia for the Year, 1932.

To the Hon. the Minister for Mines.

Sir,

I have the honour to submit the Annual Report of the Department for the year 1932, 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, 31st March, 1933.

DIVISION I.

The Hon. the Minister for Mines.

I have the honour to submit for your information a report on the Mining Industry for the year 1932.

The value of the mineral output of the State for the year was £2,890,238, an increase of £365,681 over the year 1931. The production of Coal and Silver Lead, Tin, and tantalite ores further declined, but substantial increases, both in quantity and value, were recorded of Gold, Gypsum, Arsenic and Silver.

The normal value of the Gold yield was £2,572,260, being 89 per cent. of the total output value.

The value of the Coal output was £270,630; Arsenic, £26,161; Tin, £3,295; Tantalite, £2,684; Silver, £5,604; Asbestos, £1,762; Gypsum, £5,354; Lead, £112; Felspar, £1,399; Glauconite, £930.

Dividends paid by mining companies amounted to £217,968, in comparison with £53,125 in the preceding year. In addition, bonuses to the amount of £31,250 were paid, and two companies returned capital to the extent of £117,500, details being given in Table 6.

To the end of the year 1932, the total dividends paid by mining companies amounted to £29,097,630. To the same date the total value of the mineral production was £180,708,432, of which the gold production accounts for £167,450,165, based on nominal values; but premiums from sales of gold during 1920-1924 and 1930-2, and payments under "The Gold Bounty Act, 1930," increased by £5,501,619 the totals of the mineral and gold productions respectively.

GOLD.

The Gold yield shows an increase, being 94,989 fine ounces greater than 1931, which was 94,203 fine ounces greater than in 1930.

The average value per ton of ore treated, in the State as a whole, fell from 44.81 shillings in 1931 to 38.37 shillings in 1932; in the East Coolgardie District, which produced approximately 61 per cent. of the State's reported yield, it fell from 54.05 to 44.07 shillings per ton. The average values for the Wiluna and Mt. Malcolm Districts were 26.07 and 28.89 shillings per ton respectively, though the average increased price for gold during the year of 71.2 per cent. would materially add to these values.

The tonnage of ore treated in 1932, 1,327,021 tons, showed an increase of 344,858 tons over the year 1931. The increased tonnages were produced from East Coolgardie (173,780), East Murchison (121,171), Mt. Margaret (23,007), Murchison (15,362), Yilgarn

(5,967), Yalgoo (2,203), North Coolgardie (991), Phillips River (974), Pilbara (362), State generally (338), and North-East Coolgardie (246). In the Dundas, Peak Hill, and Coolgardie Goldfields there were decreased tonnages of 1,893, 333, and 77 tons respectively.

There were increases in the outputs from Broad Arrow, East Coolgardie, East Murchison, Kimberley, Mount Margaret, Murchison, North-East Coolgardie, Phillips River, Yalgoo, and Yilgarn, but lessened production from Ashburton, Coolgardie, Dundas, Gascoyne, North Coolgardie, Peak Hill, and Pilbara.

The acreage held under mining lease for all minerals is 54,119 acres, being an increase of 1,067 acres, when compared with 1931.

The area held for gold mining is greater by 2,015 acres, and for other minerals lesser by 948 acres.

The area held under prospecting areas is 32,931 acres, including 4,395 acres for Coal. This is a decrease of 1,884 acres on the area held in 1931, the area held for Coal being lesser by 24 acres, and for other minerals by 1,860 acres.

The number of men engaged in all classes of mining was 8,695; an increase of 1,548 on the number employed in 1931.

The number of men engaged in mining for minerals other than gold showed a decrease of 91. There was a falling off in Coal mining, but increases in mining for Tantalite, Tin, Asbestos, Gypsum, Lead, Glauconite and Felspar. In gold mining there was an increase of 1,639.

The average value of gold produced per man employed on gold mines was £372.82 in 1931, and £328.43 in 1932, calculated at normal value.

The average tonnage raised per man was 172.85 tons, and in the previous year 171.55 tons; an increase of 1.30 tons.

The seventh periodical examination under the Miners' Phthisis Act of persons employed in the mines was completed on the 31st December, and the results of this examination, together with the results of previous examinations, are shown in the following table:—

Table showing Results of Miners' Phthisis Examinations from inception of Act to 31*st December*, 1932.

Examinations.	Total No. of men examined.	Normals, etc.	Silicosis Early.	Silicosis Advanced.	Silicosis plus Tuberculosis.	Tuberculosis only.
First Examination (1925–26)	4,023	3,239 % 80·5	459 % 11·4	183 % 4·5	131 % 3·3	11 % ·3
Second Examination (1927)	3,728	3,116 % 83·6	381 % 10·2	93 % 2·5	128 % 3·4	10 % ·3
Third Examination (1928)	3,483	2,977 % 85·5	362 % 10·4	98 % 2·8	42 % 1·2	4 % ·1
Fourth Examination (1929)*	2,588	2,120 % 81·9	326 % 12·6	94 % 3·6	41 % 1·6	7 % ·3
Fifth Examination (1930)	3,399	2,785 % 81·9	383 % 11·3	67 % 2·0	114 % 3·3	50 % 1·5
Sixth Examination (1931)*	3,012	2,530 % 84·0	346 % 11·5	53 % 1·8	58 % 1·9	25 % ·8
Seventh Examination (1932)	4,285	3,835 % 89·5	373 % 8·7	53 % 1·2	16 % ·4	8 % ·2

Note.—No examinations at the outlying Goldfields were carried out in 1929 or 1931, only the men employed in the Mines in Kalgoorlie and surrounding districts being examined during those years.

A comparison of the figures for 1932 with those of the initial examination in 1925-26 clearly indicates the effective manner in which the disease has been checked. The apparent increase in the number of early silicotic and tuberculosis cases reported in the 1930 examination was due to improvements in the apparatus used for X-ray work, which greatly facilitated detection of the disease.

In the East Murchison field there was an increase of 42,082 fine ounces.

In the Black Range district prospecting was active and resulted in an improved output.

At Barrambie several parties were engaged, but the absence of crushing facilities retards development.

At Birringrin a mill erected on the "Pelerin" Lease operated periodically during the year, mainly for the public. About 735 tons were crushed for an output of 137 fine ounces. No new discoveries were made.

At Bellchambers the production was approximately 239 fine ounces, the main producers being the Georgina and Rainbow Mines.

At Hancocks and Maninga Marley a small amount of prospecting was being done.

At Montagu two (2) treatment plants were erected and one engaged in public crushing. This centre produced 718 fine ounces.

At Nungarra there was only a small output, the grade of ore being poor.

At Sandstone there was considerable improvement. A rich discovery was made on the Lady Mary Lease in the vicinity of the old Oroya East. This centre produced 3,027 fine ounces, and 10 fine ounces of dollied gold.

At Youanmi only a small amount of prospecting was being done.

In the Lawlers district there was increased activity evidenced by the erection of two 5-head mills, which should considerably increase future production. The output was slightly in excess of the previous year. Returns were reported from Kathleen Valley, Darlot and Mount Sir Samuel, where the leased State plant, which had been closed down for some time, was again operating.

In the Wiluna district there was a substantial increase, mainly attributable to an enhanced production by the Wiluna Gold Mines, Ltd. This company carried out an extensive development programme and greatly added to its treatment plant. It employed an average of 700 men. At Corboy's Find there was an increase of 518 fine ounces in the output. At Cole's Find the output showed a slight decrease. At Diorite there was a falling off. At Mt. Eureka there was an output of 102 fine ounces, the principal producers being the "Mt. Eureka" and "Little Greta." The future of this district, especially at Wiluna itself, is most promising.

The Murchison field had an increase of 1,302 fine ounces.

In the Meekatharra district there was a decrease, although the tonnage treated was larger. The principal activity was at Meekatharra itself, from whence comes the bulk of the output, and where a large number of men are employed. In the outlying centres most activity was in evidence at Nannine, Gum Creek, and Gabanintha, but prospectors were also at work at Abbotts, Garden Gully, Jilawarra, Mount Maitland, Quinns, Stake Well, Yaloginda, and a few other localities.

In the Cue district there was an increase of 2,384 fine ounces. Crushings were reported from Behring Pool, Cuddingwarra, Culculli, Mindoolah, Tuckabianna, Tuckanarra, and Weld Range, also from Cue itself, where the new State plant is now in commission. At Cuddingwarra diamond drilling is being carried out on the Big Bell Mine by a strong corporation and also on the Mararoa Company's Leases at Reidy's. Both of these properties are expected to develop satisfactorily.

In the Day Dawn district there was a decrease. From Day Dawn a number of crushings were reported.

At Lake Austin there was a small production from the "Eureka" which, at the close of the year, was under exemption, but is expected to be again producing shortly.

From Mainland and Pinnacles small outputs were reported, and a few men were employed at each centre.

In the Mount Magnet district there was an increase of 2,075 fine ounces. At Mount Magnet the "Hill 60" Mine maintained regular production. In addition, the "Neptune" and "Hesperus Dawn" had good returns.

The discovery of deep alluvial at Boogardie attracted a large number of men to the locality, but, although several claims had returns, results generally were not up to expectations.

At Lennonville a fair number of prospectors was employed. Also at Paynesville. From Moyagee there was one small crushing, but this centre was very quiet.

The Peak Hill Goldfield had a decrease of 859 fine ounces. Crushings were reported from Jimble Bar, where a State Battery is operating, Mount Padbury, Murphy's Well, Mount Seabrook and Ruby Well, but the principal activity was in the vicinity of Peak Hill itself, where a fair number of men was continuously employed.

At Wilthorpe, a couple of prospectors were operating, but no gold was reported.

At Horseshoe, the Manganese deposits were unworked, and only a small amount of alluvial was recovered by the sole prospector there.

The Yalgoo Field had an increase of 1,740 fine ounces.

There was considerable prospecting activity at the various centres throughout this field, and all reported outputs. The State Battery at Payne's Find operated for two (2) months only, but those at Warriedar and Yalgoo for the greater part of the year.

The Mount Margaret Field had an increase of 2,200 fine ounces. In the Mount Margaret and Mount Morgans districts there was little change, excepting that more prospectors were at work. The diamond drilling carried out on the old "Lancefield" Mine did not yield encouraging results. The State Mill at Laverton was kept going for a good portion of the year. A find was reported from the Livesey Ranges, about 350 miles North-East from Laverton, and a number of exploratory parties were formed to investigate it. To a great extent their efforts were frustrated by climatic conditions, and so far the report is not confirmed.

In the Mount Malcolm district there was a small decrease. The principal mine, the "Sons of Gwalia," maintained its production and also carried out active development. It is now in a most satisfactory position, and has repaid the Government the whole of the money which was loaned for the purpose of enabling it to carry out a definite developmental policy, which has been accomplished with entirely satisfactory results. Crushings were reported from the outlying centres of Cardinia, Doyle's Well, Lake Darlot, Malcolm, Mertondale, Mt. Clifford, Poison Creek, Waitckouri, and Webster's Find, indicating that prospectors are operating over a very large area.

The Coolgardie Field had a decrease of 1,046 fine ounces. Many prospectors were operating in the vicinity of the town with encouraging prospects. The State Mill was running practically continuously throughout the year. At Tindals nothing was done, but it is expected that ample capital will be available shortly for carrying out operations on a large scale. At Gibraltar a few parties were working, and some crushings were reported. At Burbanks and Bonnievale no crushings were recorded, although a few

prospectors were about. At Widgiemooltha a good deal of activity was in evidence, and the Wannaway centre attracted considerable attention, some good values being unearthed in quite a number of places. About 50 men are still at Larkinville searching for alluvial.

Crushings were reported from Higginsville, Red Hill, and St. Ives.

In the Kunanalling district there was a small increase, the "Carbine" Mine being the chief producer. At the various centres a good deal of prospecting was being done.

The North Coolgardie Field recorded a decrease of 882 fine ounces.

The Menzies district recorded a diminution of output. In the vicinity of Menzies many prospectors were operating, and several good crushings were reported.

At Yundaga considerable activity was maintained. Goongarrie had the attention of a few prospectors, and good returns from one property were noted. At Comet Vale the Sand Queen-Gladsome Mine was under exemption, but other shows were being worked but no crushings reported. Copperfield and Mount Ida were very quiet.

In the Ularring district there was an increase, due to cyaniding operations on various old dumps of tailings. In addition, a few crushings were reported. At Mulline a few prospectors were working, but there were not any important developments. At Ularring and Riverina mining remained dormant.

In the Yerilla district there was a small increase. The principal production was from the "Patricia South," at Patricia. At Yarri only a few men were employed. At Edjudina there was much activity, and several good returns. Considerable attention was paid to Pinjin, much good prospecting work being done. Yerilla remained very quiet.

The Niagara district had a small increase. The principal production was from Kookynie, but returns were also reported from Jessop's Well, Niagara, and Tampa. Mining generally showed an improvement, but no new finds or important developments were reported.

The North-East Coolgardie Goldfield had a small increase. There were no finds reported and mining generally was rather quiet. The majority of prospectors were in the vicinity of Kanowna. Returns were reported from Gindalbie, Gordon and Kalpini, but only a few men were employed at each of these centres. Mulgabbie and the Six-Mile were exceedingly quiet.

In the Kurnalpi District there was a decrease and mining was very dull. Only a few small crushings were reported.

The Broad Arrow field had an increase of 3,365 fine ounces. This field maintained its reputation as an attractive one for prospectors, who were at work in every centre, and quite a large number of excellent crushings were recorded.

The State Mill at Ora Banda ran practically continuously, and this centre gives much promise. In the vicinity of Broad Arrow itself many parties were at work. Fenbark continued active during the first half of the year, but values subsequently became low. At Black Flag a few men were at work, and some crushings were raised. The discovery in the neighbourhood of Carnage, referred to last year, did not come up to expectations, but the locality is still being exploited. At Waverley matters were brisk and several crushings were reported. From Windanya, a centre that had been deserted, a very fine crushing was reported. The brightest centre was Grant's Patch, where a mild rush occurred early in the year, and a large number of holdings were taken up. Many good crushings were raised, and, as developments continued very satisfactory, the outlook is promising.

Balgarrie, Credo, Canegrass, Paddington and Dixie were very quiet.

At Bardoc a good number of prospectors were operating.

In the East Coolgardie Goldfield the number of men engaged in mining was 2,911, and in 1931, 2,388; an increase of 523. This goldfield gave employment to over 36 per cent. of the number of men employed in gold mining, and the reported production during the year was 365,620 fine ounces, over 60 per cent. of the total reported yield. The tonnage treated was 704,807 tons, being 173,780 tons greater than in 1931. The yield showed an increase of 27,780 fine ounces on the preceding year. The average grade of the ore per ton fell from 54.05 shillings in 1931 to 44.07 shillings in 1932.

The premier producer was, as hitherto, the "Lake View and Star," on which extensive development work was carried out and additional treatment plant provided.

On the Boulder Perseverance Mine a new treatment plant, which promises most satisfactory results, came into operation towards the close of the year.

At most of the other large mines steady progress was in evidence and outputs were well maintained. At the North End of the field a large amount of prospecting was being done, and the Broken Hill Proprietary Company commenced production from the old "Hannans North," on which a treatment plant is in course of erection. To meet the increased crushing requirements and to relieve the congestion at adjacent State Mills the Department leased a private plant at Golden Gate which commenced operations in April, and has put through a very large tonnage.

At Hampton Plains a good deal of activity was noticeable.

At Binduli, Golden Ridge, and Boorara a few prospectors were working.

There was considerable activity at Mt. Monger, and several good crushings were reported.

In the Bulong District, at all centres, matters were rather quiet.

The Yilgarn Field had an increase of 5,484 fine ounces.

At Hope's Hill, Kennyville, Marvel Loch and Mt. Jackson treatment plants, previously idle for considerable periods, were re-commissioned and crushing for the public undertaken. Appreciable tonnages were reported from centres which had been a long time dormant. The activity at Bullfinch continued throughout the year, and a plant for treatment of tailings started operations. The "Radio" and "Radio

Deeps" at Manxman maintained their average production of high grade ore.

The provision of crushing facilities at Kennyville resulted in a large increase in the tonnage treated in that District. A new find on private property, called "Reynold's Find," was located, but its extent has not yet been ascertained. At Mt. Jackson good returns were obtained from the two new leases and tonnage produced from prospecting areas averaged over half-an-ounce to the ton. The Princess Royal Co. at Westonia showed an increase both in tonnage and gold recovered, the cyaniding operations giving good results.

The Dundas Field recorded a decrease of 776 fine ounces. A good deal of prospecting was being carried out and a large number of prospectors had regular crushings, but nothing outstanding was noted. The Norseman Gold Mines commenced active developmental work on the "Butterfly" Leases and prospects were very encouraging. Work was continued on the "Mararoa" and "Berserker" Mines, and also several other properties. The old Buldania group was again taken up, but very little work was done thereon. No new finds were reported.

The Phillips River Field had an increase of 454 fine ounces. The enhanced price of gold greatly stimulated prospecting and mining activity in this field. The outstanding district was Hatter's Hill, where a 5-head mill was erected towards the end of the year and where an average of 20 men has been engaged, practically all of them on gold.

At both Kundip and Ravensthorpe there was a good deal of activity, and treatment plants are being erected at each.

The Pilbara Field recorded a decrease of 54 fine ounces.

A good many prospectors were at work throughout the field, and the majority were making more than good wages. Crushings were reported from Marble Bar, Bamboo Creek, Lalla Rookh, Warrawoona and a couple of other centres. If the enhanced price of gold is maintained, the outlook for this field is promising. There was not any production from the West Kimberley Goldfield and no mining work was being done.

The Ashburton Goldfield recorded a decrease of 15 fine ounces, the Kimberley Goldfield an increase of 62 fine ounces, and the Gascoyne Goldfield a decrease of 4 fine ounces. In each of these fields mining is almost entirely restricted to fossicking for alluvial. From districts outside the proclaimed goldfields productions were reported from West Pilbara, where, however, mining was not very active, only a small number of prospectors working; Burracoppin, where about half a dozen men were regularly employed, but no development of note transpired; and Toodyay District, where about 30 men engaged in dry blowing and sluicing operations at Jumperdine. A small tonnage was also raised from a leader in the locality and will be sent to Coolgardie for crushing early in the new year.

TIN.

The quantity of tin exported was 37 tons, valued at £3,295; a decrease in tonnage of 2 tons, and in value of £650. The production reported was 7 tons, valued at £684 from the Pilbara Goldfield, and 8.25 tons, valued at £725, from the Greenbushes Mineral Field.

At Greenbushes there was a slight improvement in mining activity.

TANTALITE.

Ten (10) tons, valued at £2,684, were exported; a decrease in tonnage of 2 tons, and in value of £269. The production reported was 6.36 tons, valued at £1,777 from the Pilbara Goldfield, and .45 of a ton, valued at £135 from the Greenbushes Mineral Field.

COPPER AND LEAD.

No copper or lead was exported, and no production was reported. Mining for these minerals was at a standstill.

COAL.

The output of coal was 415,719 tons, being 16,681 tons less than in 1931. All the production was from six (6) collieries at Collie. No work was done on the deposits at Wilga.

The number of men employed, 604, was lesser by 148 men than in 1931, and the output per man was in 1931 575 tons, and in 1932 688 tons. There was not much change in the Collie Field from the preceding year.

OIL.

The Freney Kimberley Oil Company were boring during the year, but results were indeterminate. Surface explorations in the Wooramel, North-Western, and South Coastal areas were also carried out.

ASBESTOS.

The reported production was 109.95 tons, valued at £1,762; an increase in tonnage of 1.88 tons, and in value of £316. This was raised in the West Pilbara District.

OTHER MINERALS.

The quantity of silver obtained as a by-product and exported was 58,285 ounces, valued at £5,604; an increase in ounces of 14.546, and in value of £2,771. Lead and silver lead amounting to 8 tons, valued at £112; a decrease in tonnage of 16 tons, and in value of £158. Also 1,477 tons of arsenic, valued at £26,161; 361 tons of felspar, valued at £1,399. The production was reported of 186 tons of glauconite, valued at £930; 3,647 tons of gypsum, valued at £5,354, and 76 tons of pottery clay, valued at £47.

MINING GENERALLY.

The Western Australian gold production was 68.09 per cent. of the total for Australasia, and in the preceding year 69.78 per cent.

In mining for base metals there was not any improvement, nor is the present outlook indicative of an early revival. The low prices resulted in mining for them being practically neglected. In gold mining a great advance was again recorded. The majority of the goldfields reported increased outputs and everything points to still further improvement in

1933. In recent years great progress has been made in mining practice, the installation of modern machinery and equipment on several mines and the provision of treatment plants in conformity with the latest metallurgical practice has resulted in reduced costs.

The continued enhanced price of gold and high rate of exchange have helped the industry enormously. During the year action was taken to suspend payment of the gold bonus after September 30th until such time as the price of gold does not exceed £5.10.0 per ounce at the Melbourne Mint.

The policy of assisting prospectors with loans of equipment and in special cases grants of sustenance, explosives, railway fares and freight was continued. The Board dealing with this matter granted 341 new applications, comprising 524 men, and extended 405 existing, comprising 605 men, a total of 746 applications, comprising 1,129 men. The expenditure had to be carefully watched and was kept to the very low figure of £930 5s. 2d., equivalent to £1 15s. 6d. per man.

From 1st September, 1919, when the State Prospecting Board came into existence, 2,861 parties, employing 4,656 men, have been assisted at a total cost of £73,396 3s. 6d. A greater proportion than in the previous year reported crushings, and, although most of the ore was low grade, the high price ruling for gold generally assured some return for their efforts. However, quite a number had returns over the ten pennyweight standard.

Repayment of the expenditure incurred by the Department was also made by several parties. Apart from those assisted by the Board, there are many out who are either relying on their own resources or are being backed by friends. Weather conditions were generally favourable during the year.

The area under prospecting areas, for gold and minerals, apart from coal, viz., 28,536 acres, is less by 1,860 acres than in the preceding year, probably explained by a preference to take up leases, the acreage held under which showed an increase greater than the falling off in prospecting areas.

The expenditure incurred in rendering assistance to mine owners and the industry generally under the provisions of the Mining Development Act totalled £24,089 10s. 8d., and in the preceding year £30,545 8s. 4d. In addition guarantees to banks on behalf of mine owners were in existence, the liability in this connection amounting to £12,875.

PART II.—MINERALS RAISED.

TABLE 1.

Quantity and Value of Minerals produced during Years 1931 *and* 1932.

	Description of Minerals.	1931.		1932.		Increase or Decrease for Year compared with 1931.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
			£		£		£
1.	Arsenic (exported), statute tons	409	7,291	1,477	26,161	+ 1,068	+ 18,870
2.	Asbestos (reported), statute tons	108	1,446	110	1,762	+ 2	+ 316
3.	Coal (raised), statute tons	432,400	336,178	415,719	270,630	— 16,681	— 65,548
4.	Felspar (exported), statute tons	104	423	361	1,399	+ 257	+ 976
5.	Fuller's Earth (reported), statute tons	30	86	...	...	— 30	— 86
6.	Glauconite (reported), statute tons	...	...	186	930	+ 186	+ 930
7.	Gold (exported and minted), fine ozs.	510,572	2,168,771	605,561	2,572,260	+ 94,989	+ 403,489
8.	Gypsum (reported), statute tons	222	304	3,647	5,354	+ 3,425	+ 5,050
9.	Lead and Silver Lead Ore (exported), statute tons	24	270	8	112	— 16	— 158
10.	Pottery Clay (raised), statute tons	7	22	76	47	+ 69	+ 25
11.	Sand (exported), statute tons	24	35	...	...	— 24	— 35
12.	Silver (exported), fine ozs.	43,739	2,833	58,285	5,604	+ 14,546	+ 2,771
13.	Tantalite (exported), statute tons	12	2,953	10	2,684	— 2	— 269
14.	Tin (exported), statute tons	39	3,945	37	3,295	— 2	— 650
		...	£2,524,557	...	£2,890,238	...	+ £365,681

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
Total since 1902 ...	361,602,229	143,403,998	39·66

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.					
	1931.	1932.	Percentage for each Goldfield.		Average Value of Gold per ton of Ore treated.	
			1931.	1932.	1931.	1932.
	fine ozs.	fine ozs.			shillings.	shillings.
1. Kimberley	2	64	·001	·011	174·44	...
2. Pilbara	3,994	3,940	·771	·657	120·87	105·62
3. Ashburton	26	11	·005	·002	...	191·88
4. Gascoyne	4	...	·001	...	...	...
5. Peak Hill	3,050	2,191	·589	·365	37·08	27·97
6. East Murchison...	63,660	105,742	12·288	17·641	24·21	26·07
7. Murchison	26,158	27,460	5·049	4·581	45·01	36·04
8. Yalgoo	3,686	5,426	·711	·905	37·07	43·28
9. Mt. Margaret	43,486	45,686	8·394	7·622	33·18	28·89
10. North Coolgardie	7,266	6,384	1·403	1·065	121·00	89·02
11. Broad Arrow	4,916	8,281	·949	1·382	61·91	74·01
12. North-East Coolgardie	789	894	·152	·149	79·44	69·68
13. East Coolgardie	337,840	365,620	65·214	60·996	54·05	44·07
14. Coolgardie	10,317	9,271	1·992	1·547	66·12	59·77
15. Yilgarn	9,294	14,778	1·794	2·465	48·61	56·53
16. Dundas	3,277	2,501	·633	·417	43·62	47·34
17. Phillips River	163	617	·032	·103	143·17	48·94
State generally	117	555	·022	·092	105·16	109·71
Totals and averages	518,045	599,421	100·000	100·000	44·81	38·37

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 and dollied 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.

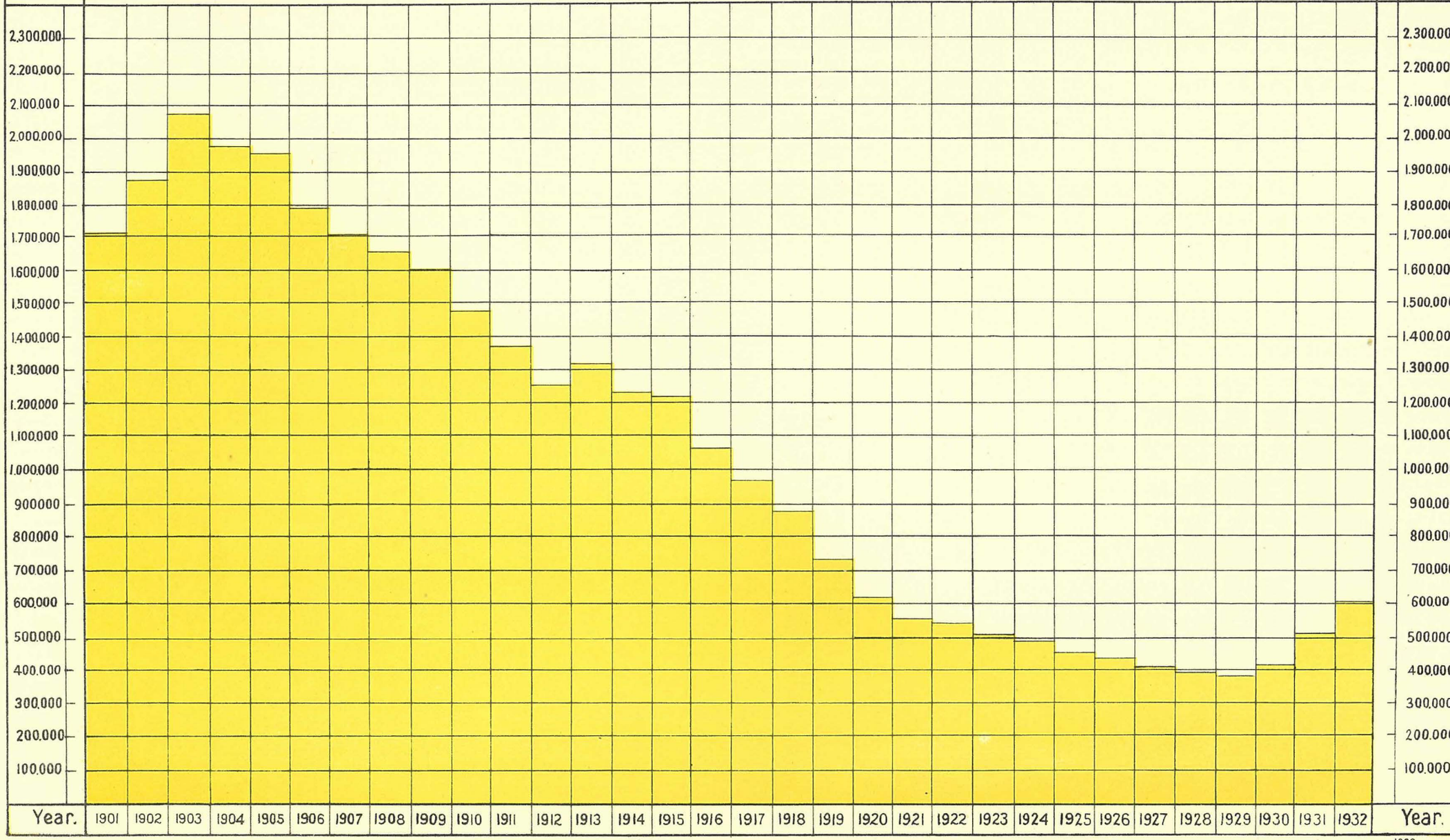
Averages of Gold Ore raised and treated, and Gold produced therefrom, per man employed on the several Goldfields of the State, during 1931 *and* 1932.

Goldfield.	1931.				1932.			
	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	49·25	23·01	70·07	32·74	60·94	30·18	66·04	32·70
3. Ashburton	...	...	...	...	...	...	...	...
4. Gascoyne	...	...	...	...	...	...	...	...
5. Peak Hill	317·57	139·73	138·61	60·99	229·42	102·35	73·07	32·60
6. East Murchison	526·90	267·87	150·14	76·33	543·50	296·03	166·48	90·68
7. Murchison	184·92	83·54	97·97	44·26	193·24	82·57	79·69	34·05
8. Yalgoo	53·13	29·03	23·18	12·67	53·52	27·10	27·02	13·68
9. Mt. Margaret	389·34	245·27	152·05	95·78	350·81	218·47	118·88	74·03
10. North Coolgardie	43·23	19·47	61·58	27·73	40·08	18·74	41·04	19·20
11. Broad Arrow	71·01	31·67	51·75	23·08	69·38	30·96	54·38	24·27
12. North-East Coolgardie ...	27·21	11·88	25·44	11·11	30·28	13·13	19·08	8·28
13. East Coolgardie	426·87	222·37	271·57	141·47	439·40	245·75	227·27	127·11
14. Coolgardie	83·36	22·89	64·88	17·82	60·73	26·89	37·16	16·46
15. Yilgarn	149·00	59·40	85·26	34·04	151·08	67·50	100·23	44·78
16. Dundas	187·72	86·25	96·38	44·28	121·33	49·88	67·03	27·55
17. Phillips River	16·21	9·72	27·31	16·39	26·78	18·46	13·80	9·52
Total Averages	325·29	171·55	166·42	87·77	331·40	172·85	148·25	77·32

The average value of gold produced per man above and under ground was £372·82 in 1931, and £328·43 in 1932, calculated at normal value. The average tonnage of ore raised shows a slight increase of 1·3 tons of ore per man. The average tonnage raised per man was highest in the East Murchison Goldfield, viz., 296·03 tons, average value £385·18: the next highest being East Coolgardie Goldfield, with 245·75 tons, average value £539·93. (Values calculated at normal price of fine gold.)

DIAGRAM.

of Gold output showing the amount in fine ounces of Gold exported & received at the Perth Mint from the Year 1901 onwards.



1932.

Note:— Previous to 1901 Gold Produced. 5,293,885·66 Fine Ozs.

TABLE 5.

Output of Gold from the several States of Australasia, the Northern Territory, Papua, and the Dominion of New Zealand during 1932.

	Output of Gold.	Value.*	Percentage of Total.	
			Output of Commonwealth.	Output of Australasia.
	Fine ozs.	£	%	%
1. Western Australia	605,561	2,572,259	83·657	68·093
2. Victoria	47,745	202,808	6·596	5·369
3. New South Wales	27,941	118,685	3·860	3·142
4. Queensland	23,263	98,815	3·210	2·616
5. Papua	9,981	42,397	1·379	1·122
6. Tasmania	5,937	25,219	·820	·667
7. South Australia	3,014	12,802	·420	·339
8. Northern Territory	421	1,788	·058	·047
9. New Zealand	165,452	702,795	...	18·605
	889,315	3,777,568	100·000	100·000

* Exclusive of premium.

TABLE 6.

Dividends, etc., paid by Western Australian Mining Companies during 1932 and Total to date.

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

Goldfield.	Name of Company.	Bonus.	Capital returned.	Dividends.	
				1932.	Grand total paid to end 1932.
		£	£	£	£
Peak Hill	Various Companies	...	...	...	160,666
East Murchison ...	do. do.	...	...	...	437,968
Murchison	do. do.	...	...	...	1,992,670
Mt. Margaret ...	Sons of Gwalia, Ltd.	...	...	16,250	1,144,738
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. ...	...	...	14,884	14,884
Do. ...	Boulder Perseverance, Limited	...	...	24,959	1,565,856
Do. ...	Golden Horseshoe (New), Ltd.	...	55,000	...	...
Do. ...	Great Boulder Proprietary G.Ms., Ltd. ...	...	...	65,625	6,151,592
Do. ...	Lake View and Star, Limited	...	...	65,000	65,000
Do. ...	South Kalgurli Consolidated, Ltd.	31,250	62,500	31,250	565,001
Do. ...	Other Companies	...	...	...	14,882,837
Coolgardie	... ...	...	...	...	339,495
Yilgarn	... ...	...	...	...	513,199
Dundas	... ...	...	...	...	222,625
		31,250	117,500	217,968	£29,097,630

TABLE 7.

Quantity and Value of Minerals, other than Gold and Coal, reported to the Mines Department during 1932.

Goldfield, District, or Mineral Field.	1932.		Increase or Decrease for Year compared with 1931.	
	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£
BLACK TIN.				
Pilbara Goldfield (Marble Bar District)	7	684	+ ·70	+ 153
Greenbushes Mineral Field	8·25	725	+ 8·25	+ 725
Total	15·25	1,409	+ 15·25	+ 878
ASBESTOS.				
Pilbara Goldfield (Marble Bar District)	...	...	— 2·57	— 36
State generally (West Pilbara)	109·95	1,762	+ 4·45	+ 352
Total	109·95	1,762	+ 1·88	+ 316
GYPSUM.				
Yilgarn Goldfield (Yellowdine)	366	366	+ 249	+ 249
State generally (Bandee)	1,945	2,917	+ 1,840	+ 2,730
(Woolundra)	1,336	2,071	+ 1,336	+ 2,071
Total	3,647	5,354	+ 3,425	— 5,050
GLAUCONITE.				
State generally (Gin Gin District)	186	930	+ 186	+ 930
FELSFAR.				
Coolgardie G.F. (Coolgardie)	361	1,399	+ 361	+ 1,399
FULLER'S EARTH.				
Broad Arrow Goldfield	...	...	— 30	— 86
TANTALITE.				
Pilbara Goldfield (Marble Bar District)	6·36	1,777	+ 6·36	+ 1,777
Greenbushes Mineral Field	·45	135	+ ·45	+ 135
Total	6·81	1,912	6·81	+ 1,912

There was a decided increase in the reported production of minerals during the year. The comparative revival in the building trade accounted for the quantity of Gypsum produced. In the Gingin district a deposit containing Glauconite, which is being used as a water-softening agent, is being exploited, and indications point to a new industry becoming successfully established. No further consignments of Fuller's Earth were reported. A high grade Felspar is being mined at Coolgardie and exported to the Eastern States. From Greenbushes small parcels of Tin concentrates were regularly raised and a small quantity of Tantalite was also recorded. Quotations for purchase of copper, tin, lead, and silver continued at a very low figure, and mining of these ores was practically neglected.

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 1932.

FIG. 1.

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

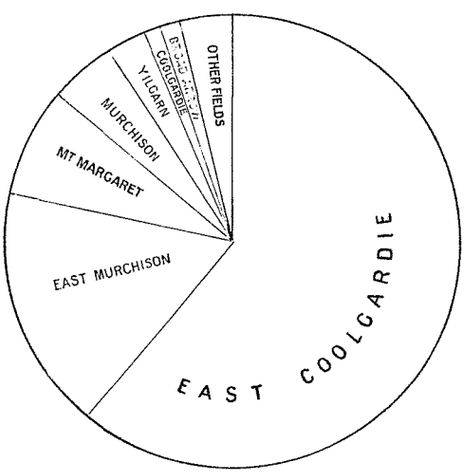


FIG. 2.

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

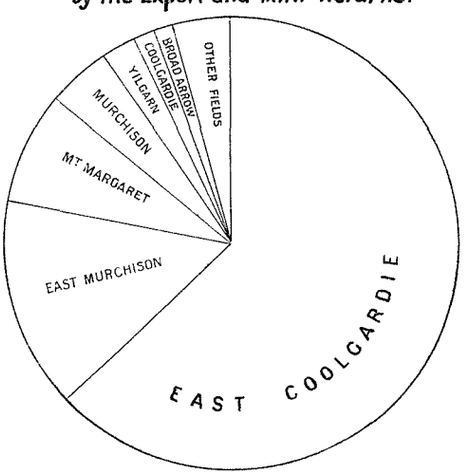


FIG. 3.

Value of Gold and other Minerals.

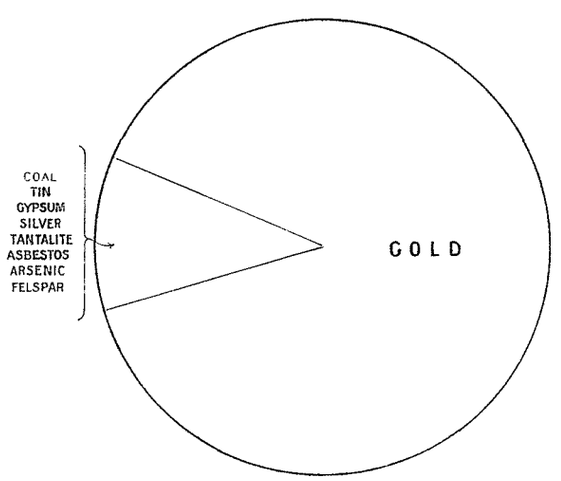


FIG. 4.

Value of Minerals other than Gold.

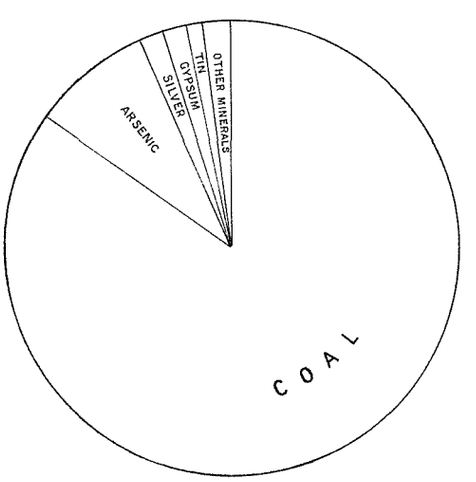


FIG. 5.

Areas of Land leased for Goldmining on various Goldfields.

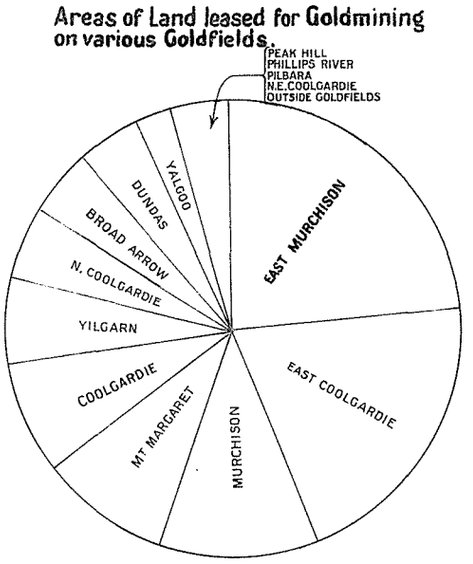
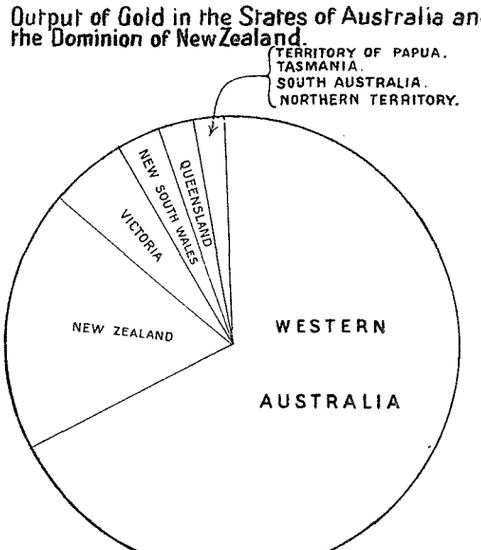


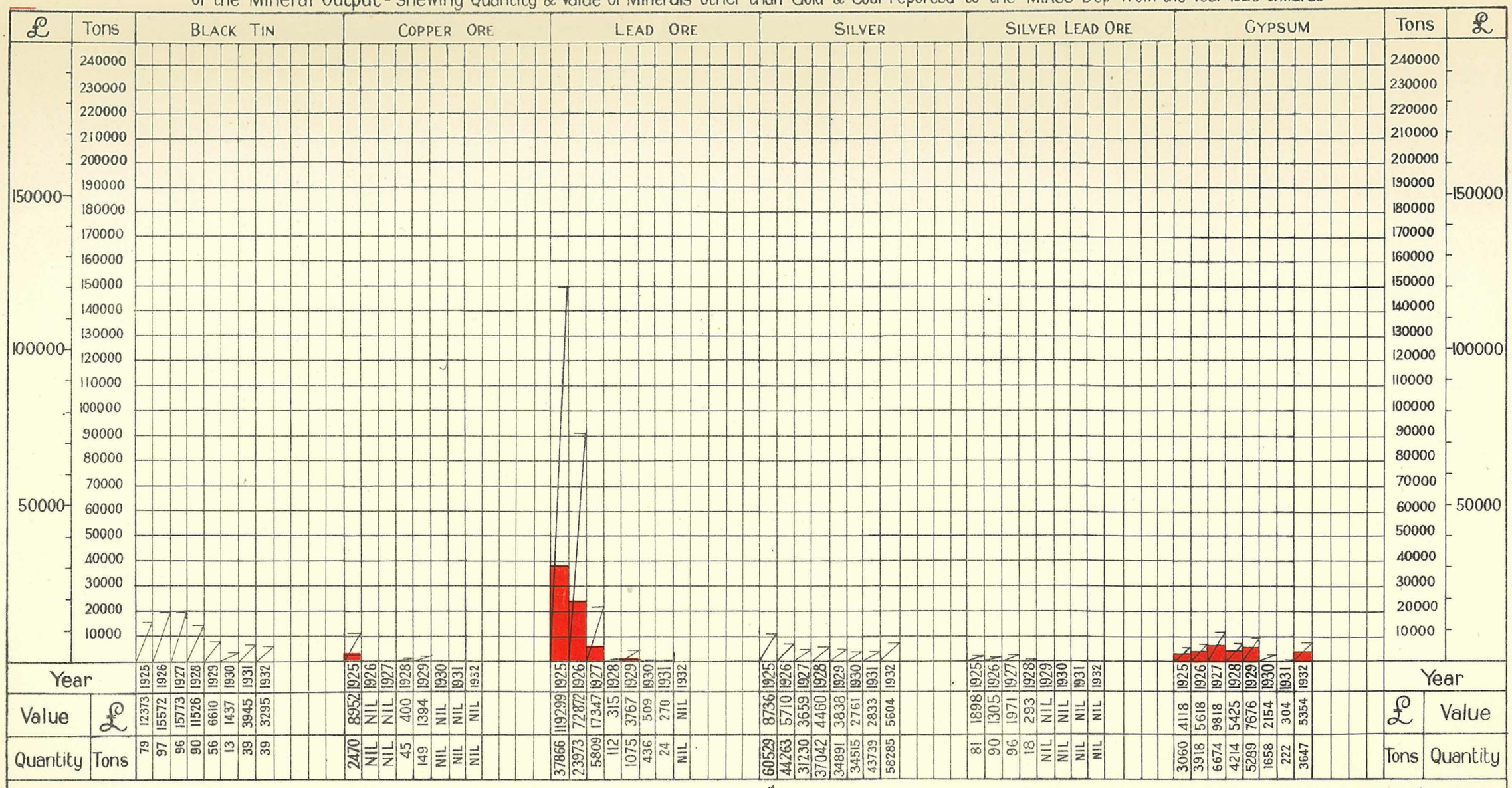
FIG. 6.

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



DIAGRAM

of the Mineral Output - shewing Quantity & Value of Minerals other than Gold & Coal reported to the Mines Dep^{t} from the Year 1925 onwards



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

Minerals not shown above

Arsenic	1477 tons	Value	£ 26,161
Asbestos	110	-	£ 1,762
Tantalite	7	-	£ 2,684
Other Minerals		-	£ 2488

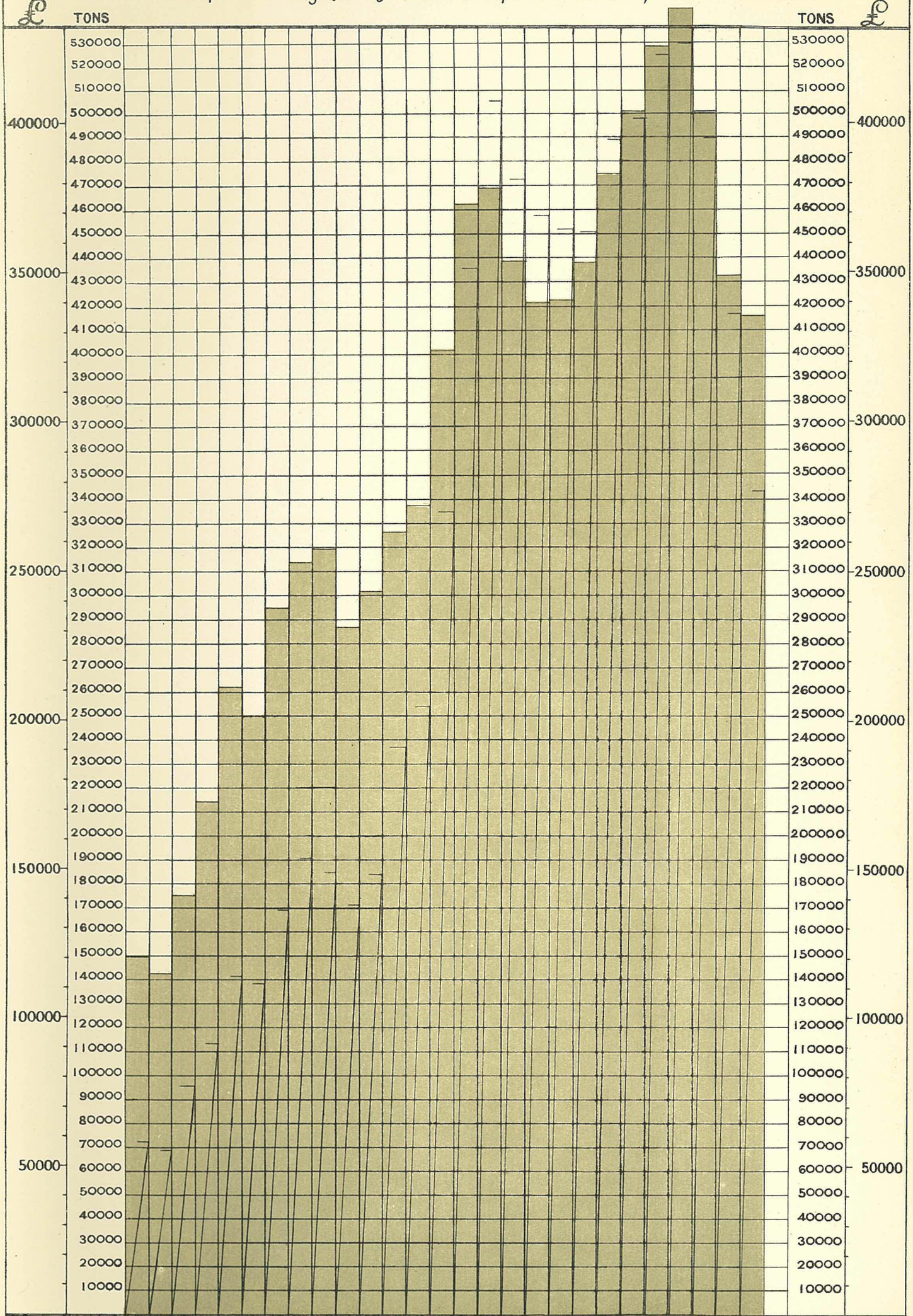
Previous to 1925 the Quantity & Value of various Minerals reported amounted to

Black Tin	16517	Tons £	1,441,326
Copper	250,759	-	1,735,875
Ironstone	57,830	-	36,695
Lead	339,485	-	1,057,487
Asbestos	858	-	37,902
Pyritic Ore	74,048	-	45,496
Silver Lead	2884	£	33,987
Tantalite	102		15,268
Limestone	93,706		18,290
Silver	2,548,212 Ozs.		357,779
Other Minerals			5,339

1932

DIAGRAM

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



Year		1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	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	£ Value
Quantity	Tons	149765	142373	175248	214302	262166	249890	295079	313818	319210	286666	301526	326550	337039	401713	462021	468 817	438443	420714	421864	437461	474819	501505	528420	544719	501425	432400	415719	Tons Quantity

1932

TABLE 8.

Quantity of Coal raised during 1931 and 1932, estimated Value thereof, Number of Men employed, and Output per Man.

Coalfield.	Year.	Quantity raised.	Estimated Value.	Men employed.		Quantity raised.	
				Above ground.	Underground.	Per Man employed underground.	Per Man employed above and under ground.
		tons.	£			tons.	tons.
Collie	1931	432,400	336,178	163	589	734	575
	1932	415,719	270,630	120	484	859	688

The average number of men employed at the collieries decreased by 148, the output by 16,681 tons, and the value by £65,548. The output per man employed underground and total number employed, showed an increase over the 1931 figures of 125 and 113 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, 1931 and 1932.

Description of Leases.	1931.		1932.	
	No.	Acreage.	No.	Acreage.
Gold mining leases on Crown land	408	6,734	538	8,715
„ „ „ private property	2	48	4	82
Mineral leases on Crown land	227	46,168	197	45,222
„ „ „ private property	5	102	4	100
Prospecting Areas	1,750	34,815	1,694	32,931
	2,392	87,867	2,437	87,050

The total number of leases held for mining purposes increased by 101, and the area by 1,067 acres, as compared with the year 1931. The number of leases for gold mining increased by 132 and the area by 2,015 acres. The number of mineral leases decreased by 31 and the area by 948 acres.

For the year 1931 the number of prospecting areas held was 1,750, of a total acreage of 34,815, including 3 areas of 4,419 acres for coal.

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.

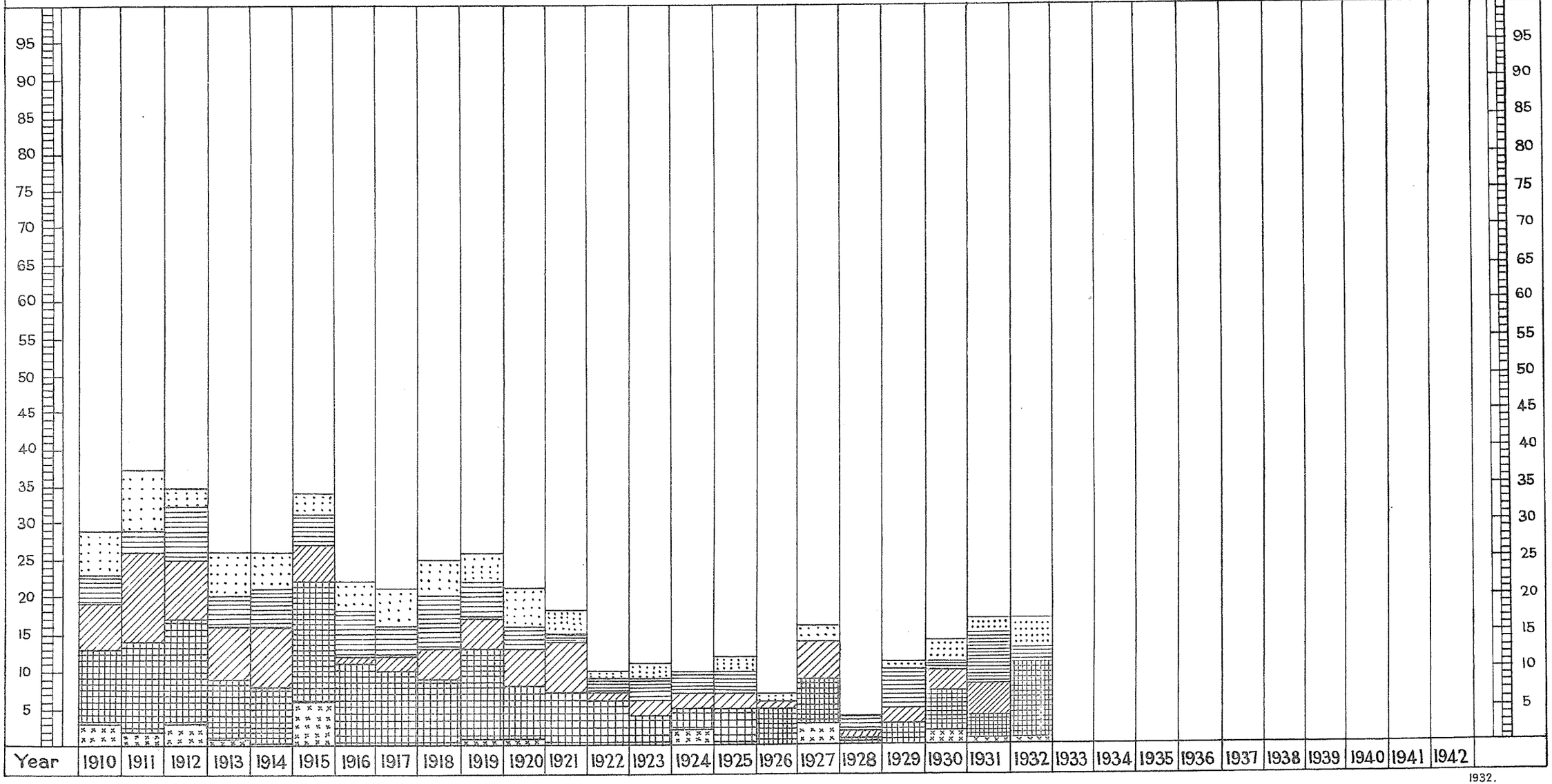
PART IV.—MEN EMPLOYED.

TABLE 10.

Average number of Men engaged in Mining during 1931 and 1932.

Goldfield.	District.	Reef or Lode.		Alluvial.		Total.	
		1931.	1932.	1931.	1932.	1931.	1932.
1. Kimberley	...	...	...	6	4	6	4
2. Pilbara	Marble Bar	109	94	16	8	125	102
	Nullagine	13	11	3	2	16	13
3. Ashburton	...	6	2	4	2	10	4
4. Gascoyne	...	...	...	12	2	12	2
5. Peak Hill	...	48	65	2	...	50	65
6. East Murchison	Lawlers	30	64	5	6	35	70
	Wiluna	654	905	...	...	654	905
	Black Range	141	195	4	1	145	196
7. Murchison	Cue	128	178	...	...	128	178
	Meekatharra	233	272	5	...	238	272
	Day Dawn	69	83	...	...	69	83
	Mt. Magnet	154	251	2	...	156	251
8. Yalgoo	...	291	393	...	...	291	393
9. Mt. Margaret	Mt. Morgans	28	94	...	...	28	94
	Mt. Malcolm	357	419	3	9	360	428
	Mt. Margaret	66	102	...	...	66	102
10. North Coolgardie	Menzies	106	120	2	3	108	123
	Ularring	40	56	...	...	40	56
	Niagara	36	51	1	6	37	57
	Yerilla	77	98	...	2	77	100
11. Broad Arrow	...	207	307	6	11	213	318
12. North-East Coolgardie	Kanowna	46	57	2	4	48	61
	Kurnalpi	22	26	1	3	23	29
13. East Coolgardie	East Coolgardie	2,303	2,811	39	40	2,342	2,851
	Bulong	44	57	2	3	46	60
14. Coolgardie	Coolgardie	282	415	240	124	522	539
	Kunanalling	56	75	1	6	57	81
15. Yilgarn	...	272	329	1	1	273	330
16. Dundas	...	73	90	1	2	74	92
17. Phillips River	...	10	58	...	...	10	58
State generally	...	60	66	25	...	85	66
Total—Gold Mining	...	5,961	7,744	383	239	6,344	7,983
MINERALS OTHER THAN GOLD.							
Asbestos	Marble Bar	3	...	...	...	3	...
	Nullagine	2	...	...	...	2	...
	West Pilbara	2	8	...	...	2	8
Coal	Collie	752	604	...	...	752	604
Glauconite	...	...	2	...	...	...	2
Gypsum	Yilgarn	3	5	...	...	3	5
	State Generally	...	14	...	...	...	14
Felspar	Coolgardie	...	2	...	...	...	2
Lead Ore	Northampton	15	16	...	...	15	16
Tantalite	Marble Bar	9	20	...	...	9	20
Tin	Greenbushes	6	33	...	...	6	33
	Marble Bar	...	...	11	8	11	8
Total—Other Minerals	...	792	704	11	8	803	712
GRAND TOTAL	...	6,753	8,448	394	247	7,147	8,695

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



1932.

EXPLOSIONS

FALLS OF GROUND

IN SHAFTS

MISCELLANEOUS UNDERGROUND

ON SURFACE INCLUDING MACHINERY

PART V.—ACCIDENTS.

TABLE No. 11.

MEN EMPLOYED IN MINES KILLED AND INJURED IN MINING ACCIDENTS DURING 1931 AND 1932.

A.—*According to Locality of Accident.*

Goldfield.	Killed.		Injured.		Total Killed and Injured.	
	1931.	1932.	1931.	1932.	1931.	1932.
1. Kimberley	...	...	...	...	...	...
2. West Kimberley	...	...	...	...	...	...
3. Pilbara	...	...	...	...	...	...
4. West Pilbara	...	...	...	...	...	...
5. Ashburton	...	...	...	...	...	...
6. Gascoyne	...	...	...	...	...	...
7. Peak Hill	...	...	...	...	...	...
8. East Murchison	2	6	71	47	73	53
9. Murchison	...	1	14	19	14	20
10. Yalgoo	...	...	1	...	1	...
11. Mt. Margaret	1	3	30	26	31	29
12. North Coolgardie	...	...	1	2	1	2
13. N.E. Coolgardie	...	...	...	...	...	...
14. Broad Arrow	...	1	3	1	3	2
15. East Coolgardie	13	3	169	158	182	161
16. Coolgardie	...	...	...	...	...	...
17. Yilgarn	...	1	1	1	1	2
18. Dundas	...	1	...	...	...	1
19. Phillips River	...	...	...	...	...	...
MINING DISTRICTS—						
Northampton	...	...	...	...	...	...
Greenbushes	...	...	...	...	...	...
Collie	1	...	118	124	119	124
Swan	...	1	13	2	13	3
Total	17	17	421	380	438	397

From the above table it will be seen that the total number of fatal accidents for the year 1932 is the same as in the preceding year, viz., 17. The numbered injured shows a decrease of 41. 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.*

	1931.		1932.		Comparison with 1931.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1. Explosives	1	17	1	9	...	— 8
2. Falls of Ground	3	37	10	41	+ 7	+ 4
3. In Shafts	4	11	...	4	— 4	— 7
4. Miscellaneous Underground	7	244	2	248	— 5	+ 4
5. Surface	2	112	4*	78	+ 2	— 34
Total	17	421	17	380	...	— 41

Sixteen fatal accidents occurred at gold mines and one at a stone quarry.* The death rate per 1,000 men employed at gold mines was 2.07 as against 2.68 in 1931.

PART VI.—STATE AID TO MINING.

The number of State Batteries existing at the end of the year was 25.

From inception to the end of 1932, gold and tin to the value of £6,815,313.41 have been recovered from the State plants; 1,667,013.44 tons of auriferous ore have been treated and have produced £5,475,321.08 by amalgamation, £972,004.21 by cyanidation, £265,-266.11 by slimes treatment, £9,354 worth from residues and 81,786 tons of tin ore produced tin to the value of £93,834, and in addition a sum of £572 was recovered from residues.

During the year the gold ore treated was 79,745.75 tons for 48,404.7 ozs. of bullion by amalgamation, producing 44,005.25 tons of payable tailing yielding 13,099.23 ozs. and 20,489 tons of unpayable tailing yielding 1,593.23 ozs., making a total of 64,494.25 tons for 14,692.5 ozs.

The working expenditure for all plants for the year was £72,913 16s. 2d. and the revenue £87,068 16s. 11d., which shows a profit of £14,155 0s. 9d. on the year's operations.

The capital expenditure since the inception of the scheme has been £423,515.24; £331,534 0s. 8d. from General Loan Fund and £91,981 from Consolidated Revenue.

The cost of administration for the year was £4,340 8s. 1d. as against £2,865 18s. 11d. for 1931.

The working expenditure from inception to the end of the year exceeds the revenue by £171,776 4s. 3d.

GEOLOGICAL SURVEY.

The field work for the past year of this Branch of the Mines Department is set out in the following list of completed reports:—

1. Inspection of the Gold Prospecting Areas at Yiniding Creek, Toodyay District.
2. Inspection of New Gold Finds on Edwards' Farming Area 450, nine miles southwest of Cockatoo Tank; also Reynolds' Find, Block 58, lying some 10 miles northeast of Bullfinch; and both in the Yilgarn Goldfield.
3. Inspection of O.P.A. 236H with regard to a Sample of Stinkstone (Stinkstein) found in a Lime Deposit on Boolardy Station, Murchison District.
4. Inspection of the Water Supply for Mining Treatment purposes at Ora Banda.
5. A Second Inspection of the Mines in the Ora Banda District.
6. Inspection of the Paringa Gold Mine, Kalgoorlie.
7. Inspection of Cameron and Paulson's Gold Mine on Mt. Stuart Station (Wyloo), Ashburton Goldfield.
8. Inspection of the Gold Mines at Ravensthorpe with regard to assisting in a public crushing plant; including taking inventory of Copper Separation Plant and Inspection of Ore purchased for Ravensthorpe Smelters.
9. Collecting further evidence for the Royal Commission on Coal Mining at Collie, including the Revision of the Collie Map and Sections.
10. Inspection of the Boring at the Lancefield Gold Mine.
11. Inspection of the Reported Find of Mineral Oil at Yarloop, South-West Division.

In addition the report on the Warburton Range Area by Mr. F. G. Forman, together with the petrological section by Mr. R. W. Fletcher, have been finalised; and the detailed report on the Western Section of the Golden Mile, by Mr. F. R. Feldtmann, has been pushed on to the final stages and is now nearly completed.

ASSISTANCE UNDER "MINING DEVELOPMENT ACT, 1902."

The following statement shows the sum advanced during the year 1932, under "The Mining Development Act, 1902":—

	£	s.	d.
1. Advanced in aid of Mining Work and equipment of Mines with Machinery	70	7	10
2. Subsidies on stone crushed for Public	851	2	9
3. Providing means of transport and equipment to Prospectors ..	955	8	5
4. Prospecting Sustenance	7,816	10	9
	£9,693	9	9
Other assistance granted from the Vote during the year on various matters totalled	£14,396	0	11
The Subsidies paid on stone crushed for the public amounted to ..	£851	2	9

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 3,414¼ tons.

*The receipts under the Mining Development Act, exclusive of interest payments amounted to and included:—	£4,701	19	0
Refunds of Advances ..	2,956	13	2
Sales of Securities	1,255	4	6
Miscellaneous Refunds ..	490	1	4
	£4,701	19	0

*The amount paid on Prospecting Sustenance is part of amount of £10,000 made available to the Unemployed Relief Department so that prospectors who are receiving sustenance from the Unemployment Relief Vote may be put under the Mining Development Vote

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 3,722, as against 3,676, total for the preceding year, showing an increase, after all adjustments, of 46 boilers.

Of the total 3,722 useful boilers, 2,205 were out of use at the end of the year; 1,467 thorough, and 29 working, inspections were made, and 1,465 certificates were issued.

Permanent condemnations totalled 12, and temporary condemnations 28. There were no conversions. Two boilers were transferred beyond the jurisdiction of the Act.

The total number of machinery groups registered was 9,550, against 9,019 for previous year, showing an increase of 531.

Inspections made total 7,235 and 3,321 certificates were granted.

180 applications for engine-drivers' and boiler attendants' certificates were received and dealt with, and 159 certificates, all classes, were granted as follows:—

Winding Competency (including certificates issued under Regulation 40 and Section 60)	7
First Class Competency (including certificates issued under Regulations 40 and 45, and Sections 60 and 63)	10
Second Class Competency (including certificates issued under Regulation 40 and Section 60)	22
Third Class Competency (including certificates issued under Regulation 45 and Section 63)	20
Locomotive Competency	3
Traction Competency	0
Internal Combustion Competency	27
Crane and Hoist Competency	6
Boiler Attendants' Competency	54
Interim	2
Copies	4
Transfers	4
Total	159

The total revenue from all sources during the year was £5,656 14s. 7d., as against £5,501 8s. 7d. for the previous year, showing an increase of £155 6s.

The total expenditure for the year was £4,667 8s. 3d., as against £5,354 15s. 1d. for the previous year, showing a decrease of £687 6s. 10d.

Part VIII.—SCHOOL OF MINES.

There was again an increase in the number of enrolments during the year, which was the 29th of the school's existence.

The individual enrolments numbered 298; an increase of 40 on the enrolments for 1931, and a marked increase over those for a number of years immediately preceding. Class attendances were satisfactory. A considerable number of students from the school have found employment in various mines.

In the Metallurgical Laboratory a large number of investigations were carried out for persons interested in the materials submitted, and in addition assistance and advice have been given to many interested in the treatment of ores and tailings. The number of assays and chemical determinations done in connection with the investigations conducted in the Laboratory was:—

Gold Assays	907
Chemical Determinations and Analyses	990

The increased activity in prospecting for gold as reflected in the large increase in the number of free assays done for prospectors during 1931 has shown signs of increasing rather than of diminishing.

The total number of assays and mineral determinations for prospectors was 1,670, and in the previous year, 1,483.

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, 31st March, 1933.

DIVISION II.

Report of the State Mining Engineer for the Year 1932.

Office of the State Mining Engineer,
Perth, 22nd March, 1933.

The Under Secretary for Mines.

Sir,

I have the honour to submit for the information of the Hon. Minister for Mines, my report on the operations of this branch of the Mines Department for the year 1932.

STAFF.

The only change in the inspectorial staff during the year was the retirement, under the provisions of Public Service Regulation 44, of Mr. E. J. Gourley, when he attained the age of sixty-five years. He retired on leave on 19th September and was appointed to an important management at Norseman. Mr. Gourley was appointed District Inspector of Mines, Kalgoorlie (after having passed the prescribed examination), on 5th January, 1914. With the exception of his service with the Australian Imperial Forces during the period of the Great War, his term was continuous.

In addition to the big mines in the Kalgoorlie District, Mr. Gourley had an extensive knowledge of the mines in the Yilgarn, Dundas and Eastern Goldfields. I desire to place on record my appreciation of the capable manner in which he discharged his duties at all times.

Applications were called to fill the vacant position, and from a number of highly qualified men, Mr. L. P. J. Gibbons was chosen. Mr. Gibbons obtained his technical education at the School of Mines, Kalgoorlie, and gained his underground experience in this State and abroad. He commenced duty on 19th January, 1933.

ACCIDENTS.

During 1932, 17 fatal and 380 serious accidents were reported to this office. The number of fatal accidents remained the same as the preceding year, a decrease being shown in the number of serious accidents.

Table 11, showing 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:—

	1928.	1929.	1930.	1931.	1932.
Fatal accidents to men engaged in mining	4	11	14	17	17*
Total number of men engaged in mining (average)	4,853	5,159	5,442	7,147	8,695
Accident death rate per 1,000 men	·82	2·13	2·57	2·38	1·96

* One fatal accident occurred at a quarry in the Swan Mining District. The remainder occurred at Gold Mines.

FATAL ACCIDENTS.

These accidents occurred under the following headings:—Explosives, 1; Falls of Ground, 10; Miscellaneous Underground, 2; Surface, 4; Total, 17. Brief reference is made hereunder:—

Explosives.—A miner was killed instantly by boring into a misfired butt. From the evidence taken at the inquiry, it appears that two holes were previously fired close together and one must have "cut out" the bottom of the other, and the deceased failed to notice the butt.

Falls of Ground.—A miner was working in a winze when a small piece of rock fell from the back which appeared quite sound. He received severe head injuries and died the next day. There was no evidence of carelessness nor neglect.

A large fall of rock from the back of a stope caused another fatality. The ground was considered heavy, but not dangerous, and all reasonable precautions were taken to ensure safety.

An unfortunate accident occurred to a machine miner who was killed by a heavy fall in an open cut. Had he remained at his machine, instead of altering his position, he would have missed the fall. The ground appeared quite safe.

Two fatalities occurred at the same time at different levels within a few days of each other. A machine miner was caught with a piece of loose ground which had apparently been missed when barring down after firing. It was concluded that the deceased had misjudged the safety of his working place. The other miner was engaged in barring down dangerous ground after firing when a piece, about 3 tons, came away from a greasy back which could not be detected before the fall. Proper precautions were being taken.

A young man lost his life through a fall of rock in some old workings. He was engaged taking out a pillar near an old shaft about 12 feet deep, and went down after firing a hole when about 8 tons came away from the hanging wall. This accident seemed

to be the result of inexperience as the ground did not appear to have been supported by any timber.

Another young man was killed when barring down a dangerous piece of ground. He tried to avoid the falling rock and fell against the wall of drive. He had not allowed sufficient space for the ground to fall.

A miner was shovelling ore into a winze when about 2 tons of ground came off the wall. Apparently the ground had been supported at the bottom by the loose rock. He had both legs broken and died a few hours afterwards. There was no suggestion of carelessness.

A young miner working in a stope in a gold mine had commenced boring with a telescopic machine when a heavy fall of ground occurred. The miner was buried by about eight tons of rock and was killed. A shift boss had visited the stope an hour before the accident and had assisted the miner to pull down some flakey ground. A foreman also visited the stope about 15 minutes before the accident, and all agreed the ground was reasonably safe. There was a decided shear plane in evidence and dry flakey heads running across the plane. As a result of inquiries that followed the accident, telescope machines are no longer used for boring uppers in stopes.

A prospector was killed in distressing circumstances by being entombed through a fall of ground in old and dangerous workings of an abandoned mine. The place where the accident occurred was about 50 feet below the surface in a worked out stope, partly filled with rock and partly supported by timbers. When the fall occurred a mate of the entombed man sought assistance and a rescue party was hurriedly organised and was able to get fairly close to him. He could not be seen but could be heard and explained that he had accidentally struck a prop and knocked it out of place, when the hanging wall had come in on him and pinned him. Strenuous efforts were made for some hours to rescue him but the ground was so much weathered and rotten that its continual subsidence prevented further operations and the rescue party eventually withdrew in most dangerous and difficult circumstances, but not before they were satisfied the prospector had been smothered. Immediately after the last members of the rescue party had been withdrawn further heavy falls of ground were heard and the ground in the vicinity of the shaft up to the surface was moving. Two members of the rescue party who could make little, if any, provision for their own safety, displayed determination, courage and energy which can fairly be described as heroism.

Miscellaneous Underground.—A workman fell down a travelling way between 240ft. level and 430ft. level. There was no witness of the accident, and no evidence was given at the inquiry to show what caused deceased to fall. The ladderways were in good order.

Two men were engaged putting in an ore chute at the bottom of a winze, when one man was struck on the head by a piece of timber which fell down the winze. There was no evidence to show where the timber came from or what caused it to fall.

Surface.—At a small newly erected battery, the construction of which had not been quite completed, a part owner in charge of the machinery, during night shift, fell into a pit recently excavated and over which a shafting and pulley were revolving. The injuries received were fatal. The plant had not been inspected by the Machinery Department and there was no guard around the pit.

Another part owner of a five-stamp battery lost his life through falling on to the main driving belt. There was a footway three feet wide over the belt but no hand rails, and in crossing it he accidentally stepped on to the belt and got jammed under the main driving pulley. The machinery had been newly erected and was also awaiting inspection.

An employee at a gold mine met his death in most exceptionally unfortunate circumstances. For some unknown reason he sat on the cover of a boiler feed tank, partly full of very hot water. The cover, made of wood planks, moved and caused the employee to fall into the scalding water. He was immediately removed from the tank but succumbed.

A very unusual accident occurred at a quarry in the Swan Mining District. When a workman was spalling stone, a piece of steel flew off the spalling hammer and pierced his lung, and he died a few hours later.

In each of the foregoing accidents the jury stated that no blame was attachable to any person.

The following table shows all the fatal and serious accidents reported to this office during 1932, and they are classified according to the gold or mineral field in which they occurred. The causes of accident are also shown:—

	Explosives.		Falls of Ground.		In Shafts.		Miscellaneous Underground.		Surface.		Total.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1.—East Coolgardie	...	2	3	4	...	4	...	112	...	36	3	158
2.—Mt. Margaret	...	...	3	3	...	...	...	15	...	8	3	26
3.—Murchison	...	1	...	2	...	...	...	12	1	4	1	19
4.—East Murchison	1	...	3	5	...	...	2	27	...	15	6	47
5.—Coolgardie	...	...	...	...	...	...	...	...	...	...	...	...
6.—Yilgarn	...	...	...	...	...	...	...	...	1	1	1	1
7.—North Coolgardie	...	2	...	...	...	...	...	...	...	...	...	2
8.—North-East Coolgardie	...	...	...	...	...	...	...	...	...	...	...	...
9.—Broad Arrow	...	1	...	...	...	...	...	...	1	...	1	1
10.—Dundas	...	...	1	...	...	...	...	...	...	...	1	...
11.—Pilbara	...	...	...	...	...	...	...	...	...	...	...	...
12.—Peak Hill	...	...	...	...	...	...	...	...	...	...	...	...
13.—Yalgoo	...	...	...	...	...	...	...	...	...	...	...	...
14.—Phillips River	...	...	...	...	...	...	...	...	...	...	...	...
15.—Collie	...	1	...	27	...	...	...	82	...	14	...	124
16.—Greenbushes	...	...	...	...	...	...	...	...	...	...	...	...
17.—Northampton	...	...	...	...	...	...	...	...	...	...	...	...
18.—West Pilbara	...	...	...	...	...	...	...	...	...	...	...	...
19.—Swan	...	2	...	...	...	...	...	...	1	...	1	2
20.—Ashburton	...	...	...	...	...	...	...	...	...	...	...	...
Totals for 1932	1	9	10	41	...	4	2	248	4	78	17	380
Totals for 1931	1	17	3	37	4	11	7	244	2	112	17	421

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 a breakages of bones, permanent injury to limbs and injuries which would cause lasting disabling effects were very closely investigated by the Inspectors of Mines.

During the past two years the number of men employed in gold mining has increased considerably. It has been impossible to obtain experienced miners to supply the demand, with the result that there has been a considerable increase in the percentage of unskilled men employed underground.

A campaign to promote the spirit of "Safety First" has been inaugurated, and it is pleasing to note that the accident rate is falling.

WINDING MACHINERY ACCIDENTS.

During the year, fourteen accidents occurred in connection with winding machinery, and included seven overwinds, three skip derailments and four miscellaneous accidents.

Overwinding.—The seven overwinds were of a minor nature, no damage of consequence occurred, and as a result of inquiries it was found that no action should be taken against the engine-drivers concerned.

Skip Derailments.—A skipman and his assistant were being lowered in the north skip to the No. 25 Level and when about 30 feet from the No. 14 plat it left the rails and travelled to the plat. The alarm acted and the skip was stopped. The men were unhurt and but small damage was done.

The electric alarm sounded when a skip of ore was ascending about 40ft. below No. 2 Level and the engine was stopped. The skip had been derailed and it is thought through coming in contact with a piece of loose rock. A good deal of damage was done to the roadway.

A skip was derailed when it was being lowered out of the tippler. No damage was done to the skip or the roadway.

Miscellaneous.—A skip was lowered below the skids at the bottom of a shaft through an engine-driver's carelessness while operating an engine in single gear. No damage was done.

The shearing of a king bolt of a skip at the nut caused the grippers to act immediately and no damage was done.

An engine-driver allowed a drum in single gear to slip through the brake with the result that the rope went down the shaft. The accident was primarily due to a braceman pulling out the chairs while the engine-driver was pulling out the clutch.

When hauling ore from the 3,300ft. level, the south skip descending empty gripped the skids at 800ft. level. The engine-driver failed to stop the engine until the full skip in north compartment reached the 900ft. level. Loose rope (fortunately an old one) entered the north compartment and got in contact with the full skip and became much tangled.

ADMINISTRATION.

Amendments of Acts.

"*The Mines Regulation Act*, 1906."—Additional Regulation 6e and Form F in the appendix, ascribed to "Diseased Persons" (gazetted 5th February, 1932).

Amendment of paragraph (g) of Section 32, General Rule (3), also cancellation paragraph (h) of Section 32, General Rule (3), and substituting an amended form (gazetted 27th May, 1932).

Cancellation of General Rule 1 of Regulation 4 and substituting an amended form. (Gazetted 27th May, 1932.)

Additional General Rules 46, 47, and 48 under Regulation 4. (Gazetted 27th May, 1932.)

Cancellation General Rule 18 of Regulation 4 and substituting an amended form. (Gazetted 26th August, 1932.)

Cancellation of General Rule 18 of Regulation 4 and substituting an amended form. (Gazetted 28th October, 1932.)

Cancellation of General Rules 46, 47, and 48 under Regulation 4 and substituting the addition thereto of Part I. and II. of the Schedule. (Gazetted 28th October, 1932.)

Cancellation of paragraphs (g) and (h) of Section 32, General Rule 3, and substituting an amended form with the addition of a Schedule (so far as relates to mines mentioned therein). (Gazetted 28th October, 1932.)

"*The Mining Development Act*, 1902-1924."—Cancellation of Regulations 7 and 11 of the Regulations under which ore will be crushed and tailings purchased at the State Battery and substituting an amended form. (Gazetted 29th January, 1932.)

Prosecutions.

Careful inquiries were made into all instances of alleged breaches of the Act, but circumstances did not warrant the prosecution of any person.

Exemptions.

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

Sunday Labour.

On one occasion during the year, permission was granted for Sunday work for two weeks to the Lake View and Star Limited, in order to expedite the stripping of Chaffers Shaft.

Loans and Subsidies.

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

	£	s.	d.
Advances towards development work and equipment of mines	70	7	10
Providing transport and general assistance to prospectors	955	8	5
*Sustenance to Prospectors	7,816	10	9
Cartage paid to Prospectors on ore treated at State Batteries crushing charges	13,265	8	7
Free crushings at State Batteries ..	315	10	6
Subsidies paid to privately owned batteries	851	2	9
Miscellaneous Expenditure	815	1	10
	£24,089	10	8

The total expenditure was £24,089 10s. 8d., compared with £30,545 8s. 4d. during 1931, and £59,137 17s. 3d. during 1930 (Appendix No. 1).

No expenditure was incurred during the year on diamond drill boring or advances on ores.

* £10,000 was placed on Development of Mining Vote on 1/7/1932 on account of amounts advanced by Unemployment Relief Department to unemployed persons engaged in prospecting operations. Figure shown represents expenditure to 31st December, 1932.

GOLD MINING.

Ore Treatment.—The increased activities forecasted in my annual reports for the years 1930 and 1931 have materialised. The following table shows the tons of ore treated, total yield and average yield of gold per ton of ore treated for the years 1929 to 1932:—

Year.	Ore treated.	Total gold yield.	Average yield of gold per ton of ore treated.
	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

In four years the tonnage of ore treated was more than doubled, and the total yield of gold increased by 222,245 fine ounces. It will be noticed that the tonnage increased but slightly in 1930, and the yield increased by 42,591 fine ounces. The average yield of gold per ton increased 1 dwt. per ton to 13 dwts. per ton, so that the increased yield was due principally to the treatment of richer ore and only slightly to increased tonnage.

During 1931, a big increase in tonnage was recorded, due principally to the commencement of treatment operations at Wiluna Gold Mines Ltd. in March of that year (215,903 tons treated), and the enlargement of the Lake View and Star Ltd. treatment plant (197,066 tons treated). The gold yield during 1931 showed an important increase of 99,278 fine ounces over the yield for the previous year, and stood at 518,045 fine ounces. It will be noticed that the average yield per ton of ore treated fell to 10.55 dwts. per ton.

During 1932 the tonnage treated was 1,327,021 tons, an increase of 344,858 tons compared with 1931 figures, and more than twice the tonnage treated in 1930. The yield was 559,421 fine ounces, an increase of 81,376 fine ounces on 1931 figures. The average yield per ton of ore treated fell to 9 dwts. per ton. The large increase in the tonnage of ore treated at big mines naturally decreased the higher averages recorded from a very large number of returns from small mines and public crushing plants. Whilst all returns, large and small, are important, it must be conceded that the industry depends very greatly on the medium and lower grade ores treated in large quantities. During the year under review the two companies above mentioned treated 668,379 tons, slightly more than half of the total tonnage for the State.

I predict the tonnage treated during 1933 (in normal circumstances) will be 1,500,000 tons or over, and that the average yield will be less than 9 dwts. per ton. The significance of the increase in the tonnage of ore treated is most satisfactory and important. It has already been stated that two companies last year treated half the total tonnage. Their treatment plants are new installations and embrace flotation concentration. Treatment up to and including flotation is wet. The concentrate is dried and roasted and the final processes are wet. The plant and machinery employed are the most efficient obtainable, and the result is that not only is a highly satisfactory recovery of gold obtained, but at a much lower cost than can be obtained in old plants. Treatment costs are not yet available, but the figures at the Lake View and Star Ltd. and Wiluna Gold Mines Ltd. must show enormous reductions compared with the dry-crushing and roasting processes. It may be of interest to repeat a paragraph from my annual report for 1929:—"Many improvements have been made in recent years relative to wet-crushing and grinding machinery. A large number of treatment plants in Australia and elsewhere are wet-crushing and grinding ores to grades of minus 150-mesh and minus 200-mesh at low costs. Kalgoorlie ores do not present any difficulties whatever relative to wet crushing and grinding, which could be done in quantity and at the present cost of power for 5s. per ton."

An all-wet treatment plant, employing the bromocyanide process for gold extraction, commenced operations during the year at the Boulder Perseverance Ltd. Its design embraces well known features of modern practice and exhibits considerable ingenuity in the arrangement of its units. It has been constructed in a thoroughly substantial manner, has a capacity of 250 tons a day, and has given great satisfaction. The old dry-treatment plant was closed down before the close of the year, and the company now depends entirely on the new plant for its returns.

References have been made in the Press to inquiries made by the Great Boulder Proprietary Ltd. relative to the installation of a new treatment plant. It is safe to state that, if a new plant is erected, it will embrace wet-treatment. Such important advances as those outlined, combined with extensive development campaigns, are doing a great deal to rehabilitate the gold mining industry.

Dust and Ventilation.—Amendments to Regulation 4, "The Mines Regulation Act, 1906," previously mentioned in this report, modified General Rule 1,

and made it conform with the provisions of the Arbitration Award dealing with ventilation. New General Rules Nos. 46 to 48, dealing with the use of carbide underground, time for blasting, and dust and ventilation respectively, restricted to scheduled mines, were brought down. Section 32, General Rule 3, paragraphs (g) and (h), relating to the use of explosives underground in scheduled mines, was also amended. It is confidently anticipated that the result of the amendments will be beneficial to the safety and health of underground workers, particularly because the creation of dust by blasting and the greater facilities for sweeping it out of the mines will be under more effective control. In conformity with procedure in previous years, careful attention was given to the ventilation and sanitation of mines. Matters relating to direction of air currents, and keeping airways open to full capacity have again claimed a great deal of attention. It is somewhat surprising to find the number of cases where air currents have been temporarily blocked, either partially or wholly, by broken rock. It is difficult enough sometimes to induce a sufficient volume of air through workings to keep the atmosphere comfortable and safe for the workers. Blockages may cause a rapid rise in temperature, and through lack of volume and velocity the air becomes charged with dust, some of which is dangerous to health. Year after year, we notice a little improvement on the part of underground workers relative to details necessary to be observed in obtaining good ventilation. A great deal can still be done by them to minimise the creation of dust and to dilute the atmosphere in many working places to a degree of safety. Men employed in any kind of work soon become more or less indifferent to or careless of its dangers, especially dangers that are not apparent, such as invisibly fine dust in mines. The use of water sprays on broken ore during handling, the proper use of blowers impinging induced air on to the faces of working places and preventing blockages of airways are important matters in which workers should take a keen interest for the protection of their health. The ventilation of the mines generally has been satisfactory. Difficulties have arisen during the year in certain places due to the nature of development programmes, and although in a few isolated cases conditions have been uncomfortable for short periods, the completion or advancement of development work has subsequently given greatly improved results.

The table given in your annual report shows the results of X-ray examinations of mine workers under the provisions of the Miners' Phthisis Act. In seven years 24,518 men have been examined, an average of 3,502 per annum, and 645 have been rejected and compensated, 537 of whom were suffering from silicosis, plus tuberculosis, and 108 from tuberculosis only, an average of 92 per annum. During 1932 there were 16 men found to be suffering from silicosis plus tuberculosis, and 8 from tuberculosis only, a total of 24. The technique of radiography has improved and a high standard of work is maintained. For years we have insisted on improvements in air currents and suppression of dust, and the combined efforts of all concerned are now being rewarded. The health of mine workers has never been so good as at present, and a most pleasing aspect of the matter is that the progress of silicosis has been so greatly retarded that it is now practically negligible. The "normals" have increased from 80.5 per cent. in 1926 to 89.5 per cent. in 1932; early silicosis has decreased from 11.4 per cent. to 8.7 per cent.; advanced silicosis has decreased from 4.5 per cent. to 1.2 per cent.; silicosis plus tuberculosis shows a decrease from 3.3 per cent. to 0.4 per cent.; and tuberculosis only 0.3 per cent. to 0.2 per cent. In addition to these results, men have also been examined since 1927 under the provisions of the Mines Regulation Act which was amended in that year. To the end of 1932, 8,306 men have been examined and 1,077 rejected and/or refused admission to the industry as suffering from specified diseases. We will strive, not only to maintain the improvement recorded, but also for the ultimate elimination of tuberculosis from the mines. By means of care and sustained vigilance in controlling all factors relating to ventilation and sanitation of mines, and with the aid of regular examinations of workers, I believe the disease can be eradicated.

Kalgoorlie Mines.—The principal gold mining centre in the State, Kalgoorlie District, has shown considerable activity. Many of the old mines are being re-examined, and practically every acre of likely ground is held under some kind of lease by companies or prospectors. An active policy of underground development was carried out in most of the big mines last year, as shown by the figures from seven properties, as follows:—Driving, 18,948 feet; crosscutting, 6,984 feet; winzing and rising, 7,472 feet; diamond drilling, 10,316 feet. Total, 43,720 feet. In addition, 986 feet of shaft stripping were completed.

The Great Boulder Proprietary had an interesting year, and plans have been made for considerable development work to prospect and open up ore bodies on the eastern side of the porphyry dyke. Work was done at various levels below No. 9 and down to No. 18, to explore "X," lode which has so far given great promise of becoming an important source of ore supply in the future. Other lodes have been located in shallow workings, and it appears that considerable quantities of fair grade ore exist in the eastern portion of the leases.

At the *Boulder Perseverance Limited* very little change took place underground; the usual monthly tonnage was easily maintained from the stopes, some of which look very well. Practically all the water from the Brown Hill line of country drains into this mine. It was found expedient to instal an electrically-driven pump at 1,750ft. level to force the water, in one lift, to the surface. The outfit works highly satisfactorily and superseded baling with tanks.

The South Kalgurli Limited continued operations in three mines, *i.e.*, South Kalgurli, Kalgurli, and Croesus. A new head gear was erected on Morty's Shaft, and the mill ran continuously and satisfactorily.

The Associated Mine worked as usual without intermission, whilst development operations were pursued at the *Enterprise, North Kalgurli,* and *Hannans North Mines.*

Considerable activity was shown at the group of mines worked by the *Lake View and Star Limited.* Development work was done in all the leases except

the "Star" and considerable quantities of ore were opened up. Some fine big stopes are being worked in the Ivanhoe, Horseshoe, and Chaffers properties, and it is asserted that reserves are at least a year ahead of the mill's requirements. Reconditioning and sinking Chaffers' Shaft has been an important factor in the development of the southern end of the leases. An interesting description of the work was contained in the report of Mr. A. W. Winzar, District Inspector of Mines, as follows:—

"One of the major items in the development programme was the stripping and sinking of Chaffers' Shaft. This entailed not only the sinking of the shaft from the 2,258ft. level to 3,300ft. level, but also enlarging and reconditioning it from the surface to the 2,258ft. level. The shaft, originally containing three compartments with an overall measurement of 4ft. 4in. by 11ft. 8in., has been enlarged to a four-compartment shaft with overall dimensions 6ft. 8in. by 19ft. The two north compartments are for haulage and are 4ft. 6in. by 5ft. internal dimensions, taking skips of three-ton capacity. The service compartment takes a cage carrying 24 men, 12 on each deck, and is of the same size as the haulage compartment. The south compartment is 2ft. 4in. by 5ft. and carries the air and water pipes, also the counter weight for the service cage.

"Operations were commenced in February, 1929, by cleaning out the bottom of the shaft at the 2,258ft. level, and sinking to the 2,609ft. level as a four-compartment shaft. The stripping of the shaft from the surface to 2,258ft. level was then considered and in February, 1931, a start was made by stripping up from the 2,258ft. level. This method had certain advantages, but it was found to be impracticable, as the timber below was too badly damaged by the falling mullock. In this way the shaft was stripped and timbered to the 2,100ft. level. To increase the rate of progress of the work, a start was made in July, 1931, on five sections, these being worked simultaneously. The main consideration was the handling of the mullock, and to facilitate this the sections were started from levels connected with Horseshoe No. 2 workings, and the mullock was used to fill stopes. The five sections were—Surface to 500ft., 500ft. to 1,000ft., 1,000ft. to 1,600ft., and 1,600ft. to 2,100ft. From survey stations established in the plats at these levels, the plat sets were marked out and placed in position. The pulling of the old timber and stripping were then carried on in 10ft. lifts. The amount of stripping that had to be done amounted to 2ft. 6in. off the north end of the shaft, 6ft. off the south end, and 1ft. off the east and west walls. Down holes, 8ft. long, were bored with 10ft. steel. These holes were fired three or four at a time to regulate the amount of mullock on the penthouse. After firing these holes a bench 2ft. high was left above the penthouse and the next round of holes was bored. The penthouse was then lowered a further 10ft. and the same procedure repeated. In October, 1932, the connection was made at the 2,100ft. level. Pilot winzes 7ft. by 4ft. were sunk ahead of the shaft from 2,609ft. level to 3,100ft. level and connections made with Chaffers' workings. This procedure served the dual purpose of eliminating haulage of broken material up the shaft and providing ventilation for the lower levels. The stripping was carried out by benching off to the pilot winzes, which were placed at alternate ends of the shaft. Twenty-four 8ft. holes were bored in the bench and these fired in one round, using five plugs of 40 per cent. fracture per hole. By keeping a rill of 40 degrees on the bench the broken material cleared itself and was trucked from the bottom of the winzes for filling stopes.

"To the 2,258ft. level the wall plates and centres are of 6in. by 6in. jarrah; from this point downward they are 8in. by 8in. The sets are at 5ft. centres and are lagged vertically with 9in. by 2in. jarrah boards. At each plat 8in. by 8in. bearers are hitched into the wall and double wall plates put on. The plat sets are all 15ft. high. The timber was swung on hanging irons, four irons to each wall plate. After being plumbed it was blocked and wedged into position. The skids are 6in. by 4in. karri, 20ft. in length, tongued and grooved at the ends. They are secured by channel irons and bolted to the centres every 5 feet. Skip pockets have been put in below the 600, 1,200, 2,400, and 2,800 ft. levels.

"Attention has been given to transport underground, and seven electric locomotives are in commission, each capable of pulling 7- to 20-ton loads. On the No. 33 level, Ivanhoe Section, the locomotives haul from Chaffers' Deeps back to the Ivanhoe, two trains drawing 12- and 7-ton loads. A charging station is on this level. On the Ivanhoe, No. 24 level, two trains haul 20- and 12-ton loads. This level is now right through to Chaffers' main shaft, and the ore can be taken either way. It is also equipped with a charging station. Locomotives are in use at Nos. 8, 10 and 12 levels, Chaffers', and haul from the Horseshoe No. 2 shaft stopes. A charging station is being put in at No. 10 level Horseshoe No. 2."

The treatment plant is nearing completion. Additional units have been installed, and it now has a capacity of 40,000 tons per month. A searching campaign, with the object of discovering possible improvements in the various sections, has been in progress for some time, and it can therefore be expected that the extraction of gold and costs, which are now highly satisfactory, will be still further improved. In the power section, a new installation, there are four 8-cylinder crude oil engines, each 1,100 h.p., direct coupled with alternators, generating current at 3,300 volts. Two air compressors have also been installed—one electrically driven, the other driven by a 4-cylinder crude oil engine. There is ample power and compressed air available for all purposes, and it is evident that generating costs must be low from such a well designed and constructed plant.

Wiluna Gold Mines, Limited.—An active programme of underground development was continued during the year, as indicated by the following footages:—Shaft sinking 88 feet, driving and crosscutting 24,148 feet, winzing and rising 6,832 feet, total 31,068 feet. The main shaft was completed to the 800ft. level, and development underground was speeded up to cope with ore requirements for the treatment plant. At 450ft. level the north drive is being extended to connect with the workings at the Essex Lease. The drive will be approximately 3,000 feet in length, 1,600 feet having already been completed. A geophysical survey is being made of the

property, and it will be interesting to all concerned in the welfare of the industry to learn the results from the work. On the surface additions were made to the power plant in the form of two Diesel type engines, and another large settler was installed at the treatment plant. At the arsenic plant considerable improvements were made, and it is intended to equip it with a Cottrell fume precipitator. This installation, when completed, should solve the arsenic fume troubles. During the year the company has been actively engaged in consolidating its position, and it can be confidently expected that its operations will be increased in the near future.

Sons of Gwalia, Limited.—References have been made in my annual reports since 1928 to the active development programme undertaken at this mine. Underground development has been extensive, and directed more particularly to exploring the lower levels in a southerly direction.

During the years 1928 to 1930, inclusive, loans of money were made by the Government in accordance with the provisions of an agreement for underground development work completed and for machinery installed, and aggregated a sum slightly in excess of £67,000. So successful was the result of work done, and so splendidly did the mine respond to it, that ore reserves were greatly increased and the difficulties encountered prior to the commencement of the development campaign gradually disappeared. At the end of the year the company completed repayment of all moneys advanced by the Government, much in advance of the time stipulated, an achievement worthy of the utmost commendation.

During the years 1928 to 1930 the company also did a lot of development work at its own expense, and also pursued a policy of active development during 1931 and 1932. In those two years the footages were as follows:—

——	1931.	1932.
	feet.	feet.
Shaft sinking	33	132
Driving	1,436	2,100
Crosscutting	1,241	870
Winzing	1,344	1,261
Rising	...	430
	4,054	4,793

An underground diamond drilling plant was acquired before the close of the year, and 796 feet were drilled. This drilling plant should prove a valuable asset in locating ore bodies, particularly in view of the fact that the three principal lodes have footwall and hanging wall branches.

An important feature in last year's operations was the work in connection with opening up No. 26 level. The plat and ore bin have been excavated and nearly 1,200 feet of driving were done, some of it south from the plat and most of it from several winzes sunk from No. 25 level to the random of No. 26 level. Before this report is issued the level will have been driven from the shaft as far as 1,700 feet south, perhaps further. The dimensions of the drive are 8 feet by 7 feet, which will permit of the circulation of large volumes of air.

The ventilation of the mine is good, great improvements having been effected in the lower levels as a result of the development campaign. Blowers are used freely, and all dead ends in No. 26 level workings are equipped with them. As soon as the drive from the shaft connects with the drive from the winze at 820 feet south, ventilation will be really good.

During the year 143,262 tons of ore were mined and treated. Early in the year the retreatment of residues, which has been undertaken continuously for about ten years in such quantities as circumstances have permitted, was completed.

The power used at the mine for all purposes other than the steam winding engine is generated from locally obtained firewood in gas producers. Gas engines drive alternators and air compressors, which in their turn produce electric current and compressed air respectively. The exhaust gases from the engines are passed through recuperators in which steam is raised and is used to supplement steam from water-tube boilers (wood fuel) for winding purposes. This utilisation of waste heat represents a very considerable economy. Steam locomotives and the necessary rolling stock and sets of rails are used to haul the "mulga" firewood from the areas, where cutting takes place, to the mine, distances between 30 and 40 miles. The yield of the bush is about 1,200 tons per square mile, and the cost of the wood delivered at the mine is approximately 17s. 1d. per ton. Electric current is produced at a very cheap cost per kilowatt hour. The average capacity of the gas plant is approximately 2,000 k.w.

Various Districts.—The marked revival in gold mining throughout the goldfields mentioned in my annual report for 1931 was maintained last year. Prospectors and syndicates worked a large number of small mines, and in the aggregate considerable tonnages of ore were treated for highly satisfactory returns. A large number of men have been attracted to the goldfields from farming districts and elsewhere. In a few cases some of them were fortunate in finding really good values. There appears to be plenty of gold to be found, but usually systematic prospecting is required to find it. Experienced prospectors are making good use of their knowledge and usually with better results than inexperienced men, although there have been a few notable exceptions. An appreciable quantity of old machinery which has been out of use for years has been reconditioned and put into commission again. There has also been a revival in the retreatment of tailing dumps, the high price of gold enabling profits to be made.

COAL MINING.

The coal mining industry experienced a quiet year; the total output of coal from the Griffin, Co-operative, Proprietary, Stockton, and Cardiff Mines amounted to 415,719 tons, compared with 431,179 tons during 1931 and 501,428 tons during 1930. The average number of men employed on the coalfield at Collie was 577, a decrease of approximately 200. Working conditions in the pits were good, the systematic direction of the air assisted by means of concrete stoppings where necessary enabled fresh air to be sent to the working faces, and timbering of the workings was well attended to. The serious accidents

numbered 124, but none were fatal or even of such a nature as to incapacitate a man from future work.

No permits for work on Sundays were granted during the year, and there were no prosecutions for breaches of the Coal Mines Regulation Act.

There was not a great deal of important development done in the mines during the year. At the Griffin Mine more systematic development was done than in any previous period since the mine was opened. The management has very wisely aimed at having the faulted portions of the colliery proven, despite the necessarily slow progress in winning out bords. The Co-operative main dip is standing on a downthrow fault, but the coal has been struck in a back heading, the displacement being approximately 100 feet. Considerable regrading in the main tunnel will have to be done before sinking is resumed. The main dip at the Proprietary is also standing on a fault. A sudden inrush of water had to be coped with, and no further development was done at the close of the year. Little, if any, change has been reported from the Stockton and Cardiff Mines.

GENERAL.

Since regulations were enacted compelling fuses to be capped on the surface at scheduled mines there has not been a single detonator accident at those mines, where many thousands of fuses were capped monthly. A few accidents caused by premature explosions of detonators still occur at unscheduled mines, and the reason usually given for such happenings is either—(1) tapping out sawdust, or (2) inserting the fuse. Invariably in such cases there are no witnesses, and we cannot obtain evidence to trace the actual causes. There is little doubt that in the majority of such cases, which are now few in number, the happenings are accidental, but it is obvious that there are unknown factors which constitute contributory causes to such explosions.

The average price of gold for the year was slightly over 145 shillings in Australian currency per fine ounce. The complicated factors controlling the price of gold, largely international, are too involved to permit a forecast of future price to be made, but it does not seem likely that it will return to normal for some considerable time, although the rate of exchange between London and Australia may fluctuate. With gold at an enhanced value, the time for bold policies is with us, and the example already set by several mining companies could very well be emulated by others. There is ample scope for a repetition of the development and equipment campaign already effected at some of the Kalgoorlie mines with such beneficial results. Those companies which take advantage of the favourable circumstances now prevailing, by effecting such improvements as may be necessary to reduce production costs, will be able to carry on profitably when gold returns to normal prices. Time and tide wait for no man.

There is an important matter that should be mentioned. I refer to pooling knowledge in all branches of mining and metallurgy. It is greatly to the credit of mine owners and officials in South Africa that so much information gained as a result of experimental research and practical experience has been published by the Chamber of Mines and thus made available to all interested. Are we doing as much in this important connection as we should do? Is the information gained by experience on the mines made known for the benefit of others? Pooling knowledge gained from experience is of the greatest assistance in the ever-increasing necessity to reduce costs. Each and every mine is seriously concerned in cost of production, and every single operation in a mine is a factor that contributes to the cost of production, be it a business or technical matter. It is therefore worthy of the closest scrutiny to ensure that it is being done to best advantage. Years ago the Chamber of Mines encouraged the writing and publication of articles in its Journal. Cannot that system be re-established with substantial benefit to the industry? Managers and their officials could produce articles of the greatest interest and value by referring to details. It is very often the little things that count for so much in recovery and cost, and discussions on relative values of differing methods of procedure are always valuable, especially when alterations or modifications adopted are illustrated by the savings effected. Let it not be thought that there is no time available for the preparation of articles dealing with operations at a mine. The fact of examining details invariably brings its reward to those concerned, sometimes in unexpected ways. Time spent in detailed investigation of procedure is essential, in my opinion, to best results, because there is the danger that we may be rather prone, in our daily work, to accept results rather than to query them. Surely the favourable conditions now prevailing in respect of gold mining offer a unique opportunity for re-establishing such a scheme. The Research Laboratory at the School of Mines, Kalgoorlie, has done extremely useful work, and although in recent years it has been difficult to finance its operations, the Government has kept it going and has published results obtained. This has been done in the interests of the industry, and in the hope that mining companies will also do what they can to support and supplement the effort.

A. M. HOWE,
State Mining Engineer.

APPENDIX No. 1.

MINING DEVELOPMENT EXPENDITURE.

	£	s.	d.
Advances outstanding 31st December, 1932:—			
Advances authorised prior to 1932 ...	238,660	18	0
Advances authorised during 1932 ...	56	0	0
	£238,716	18	0
Principal Moneys Advanced—			
Prior to 1932	211,997	2	6
During 1932	291	3	4
	£212,288	5	10
Principal Moneys repaid (including Sale of Securities)—			
Prior to 1932	42,908	13	9
During 1932	3,783	8	9
	£46,692	2	6
Bad Debts written back and amounts transferred—			
Prior to 1932	32,915	7	10
During 1932	7,619	17	0
	£40,535	4	10

	£	s.	d.
Interest paid prior to 1932	22,082	3	2
Interest paid during 1932	1,078	12	1
	£23,160	15	3
Interest outstanding at 31st December, 1931	£18,847	16	6
Interest outstanding at 31st December, 1932	£19,133	3	6
Principal Moneys Advanced	212,288	5	10
Less Principal Moneys repaid 46,692 2 6			
Less Bad Debts written off ... 40,535 4 10			
	87,227	7	4
Principal outstanding at 31st December, 1932	125,060	18	6
Interest outstanding at 31st December, 1932	19,133	3	6
	£144,194	2	0

APPENDIX No. 2.

Coal Mines Regulation Act, 1902-1926.

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

The Under Secretary for Mines.

Office of the State Mining Engineer,
Mines Department,
Perth, 17th March, 1933.

Sir,

The Annual Report of the Board of Examiners for the year 1932 is forwarded for the information of the Hon. Minister for Mines.

Examinations for Certificates.

No applications were received for the April examination, and no meeting of the Board was held in that month.

Two candidates submitted themselves for examination in October, one taking the First Class and the other the Second Class examination. At the meeting of the Board on the 11th November, it was decided that the papers warranted Certificates of Competency being issued to both candidates.

Copies of the papers set for the First and Second Class examinations are appended to this report.

These papers were exchanged with kindred boards in England and the Eastern States.

We have, etc.,

A. M. HOWE,
State Mining Engineer,
(Chairman).

T. BLATCHFORD,
Government Geologist,
(Member).

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

V. RUSSELL,
Secretary.

THE COAL MINES REGULATION ACT, 1902-1926.

Examination for First Class Certificate of Competency.

SUBJECT: ARITHMETIC.

Wednesday, 12th October, 1932: 9 a.m. to 11 a.m.

Possible Marks.		
17	1.	The cost of getting and filling coal by hand is 5s. 3d. per ton. By using coal cutters the cost is reduced 33 per cent. The output from a mine is 830 tons per day, and of this amount 375 tons are won by machines. What is the saving per ton on the gross output as a result of the use of machines?
17	2.	Two pipes *A* and *B* deliver water into a cistern. *A* can fill it in seven hours, *B* in six hours, and a third pipe, *C*, can empty it in five hours. How long will it take to fill the cistern if all pipes are opened together and *C* is closed after running 3½ hours?
17	3.	A portion of land in the form of a right angled triangle is to be divided into two parts by a fence running from the right angle to meet the hypotenuse perpendicularly at a distance of 1,760 links from one end. What is the area of each part, the length of the dividing fence being 1,320 links?
16	4.	A seam of coal is 3ft. 6ins. thick and is worked longwall. The walls are 50 feet long, and the cost of brushing the roads is 8s. per fathom. (30 cubic feet represent one ton.) Find the cost per ton.
16	5.	The velocity of air in an airway is 8 feet per second with a water gauge of 1.75 inches. What water gauge will be required for a velocity of 12 feet per second?
17	6.	The average cost of sinking a shaft to a depth of 600 yards amounted to £15 per yard, but 22½ per cent. of the distance sunk cost 40 per cent. more than the average. What was the cost for sinking the remaining 77½ per cent.?
100		

SUBJECT: GEOLOGY.

Wednesday, 12th October, 1932: 11 a.m. to 1 p.m.

Possible Marks.		
20.	1.	Describe briefly the nature and occurrence of the following rocks:—Granite, sandstone, dolerite, laterite, conglomerate, shale. What rocks occur in Collie area?
15	2.	State the main types of faults. Illustrate each by a small diagram.
15	3.	In rocks of what geological periods are coal measures most likely to occur? To what period do the Collie Coal measures belong, and what is the characteristic fossil of these measures?
20	4.	Name and describe briefly the different classes of coal. To what class does the Collie coal belong?
15	5.	How are the constituents of coal expressed in an analysis? What impurities are likely to occur?
15	6.	Explain the term "Calorific Value." In what unit is it usually expressed? On what does the calorific value of a coal depend?
100		

SUBJECT: MACHINERY.

Wednesday, 12th October, 1932: 3 p.m. to 5 p.m.

Possible Marks.		
17	1.	Find the size of a pair of haulage engines to haul by main rope 50 tons per hour up a tunnel 800 yards long having a gradient of 1 in 8 against the load. Speed, 8 miles per hour. Effective steam pressure, 70 lbs. per square inch.
17	2.	Give an account of any coal cutting machine you have seen at work, and the motive power to drive it. Under what conditions would you deem it safe to use coal cutters driven by electricity? What is the effect of overloading the power cables?
17	3.	Describe, with sketches, the "main and tail" system of working, and say under what circumstances it can be usefully applied.
16	4.	Describe, with sketches, how to erect a steel chimney 4 feet in diameter and 50 feet high made of steel plates ¼in. thick. The chimney is lying on the ground to start with, and must be placed on a completed brickwork base 4 feet high.
16	5.	An examination of the wire rope conductors in a shaft 600 feet deep has to be made. What points should be specially attended to and why? State how the examination should be made.
17	6.	Describe how to fix wire rope conductors and weights in a deep shaft, and say what other precautions should be taken to provide against the cages colliding whilst running in the shaft.
100		

SUBJECT: MINING OF COAL

Thursday, 13th October, 1932: 10 a.m. to 1 p.m.

Possible Marks.		
20	1.	A main endless-rope haulage road has been driven up an 80 feet rise fault for a distance of 320 yards. It has to be timbered and made so that it can also be used as a travelling road. Show in plan and section how to timber and arrange the necessary space.
20	2.	In a mine worked by direct haulage in two stages, it has been decided to change over to endless-rope haulage. Give a full account of the work necessary to make the change over in the shortest possible time. The face of the dip is 1¼ miles from the surface, and some of the sections are half a mile from the main road.
20.	3.	In some cases pillars are not worked till a district is finished in whole work. In others the pillar work closely follows the whole, and in others the pillars are not worked at all. State the conditions under which each system may be adopted.
20	4.	Illustrate and describe how to support a haulage road 600 yards long. The sides are good but there are 5 feet of bad roof, and the road is to be made 11 feet by 6 feet in the clear.
20	5.	An important railway line crosses the surface above a coal seam 7 feet thick, located at a depth of 300 feet. What precautions are necessary to safeguard the railway from damage?
20.	6.	As the hours actually worked by miners are reduced by the longer distances from the surface to the faces, to what points should particular attention be given in order to maintain a maximum daily output?
20	7.	A crosscut is driven diagonally across old 8 yard bords and 8 yard pillar workings. Show by sketches how to secure the crosscut in the bords, and how the pillar ends should be strengthened and protected.

20 8. Compare the "long wall" and "bord and pillar" method of working a seam of coal, and give the ideal conditions for each system.

20 9. A return airway 6 feet high and 10 feet wide is to be driven through strata broken by a 60 feet fault—

(a) what grade should the road have?
(b) with what material should it be secured?
(c) from which side of the fault should the drive be started, both ends being available?

20 10. A seam of coal 200 feet below the surface is about to be developed for an ultimate output of 800 tons per day, by means of tunnel haulage (no shafts). Give dimensions, grade, and approximate cost of driving and furnishing it ready for work.

200

SUBJECT: SURVEYING.

Thursday, 13th October, 1932: 2 p.m. to 4 p.m.

Possible Marks.

20 1. It is not possible to run a straight course from the upcast to the downcast shaft, and the following traverse has been run from the centre of the one to the other; find the length and bearing of the line joining the centres.

Station.	Bearing.	Distance. feet.	
1	... N 52° E	106·4	Stations 1 and 4
2	... S 29¾° E	40·9	are the centres
3	... S 31¼° W	76·8	of the respective
4	... ...	...	shafts.

30 2 Describe and illustrate by diagram the laying out of a curve of 20 chains radius, the angle of intersection of the tangents being 110 degrees. It is not possible to range out the whole curve from the first tangent. Chords are one chain, except the last one. Give the deflection angles for the first three sites, and for the odd length at the end.

25 3. State the requirements of a theodolite which call for the making of adjustments, and the principles underlying the making of these adjustments. Describe fully how you would make the limb of the instrument horizontal.

20 4. Following are the data of a level sectioning; reduce, and check your calculations:—

Stn.	B.S.	Int. S.	F.S.	Distance. feet.	Remarks.
B.M.	9·71	...	...	0·0	Height of B.M. 103·62 feet.
	...	3·15	...	100·0	
	7·43	...	0·23	200·0	
	...	4·17	...	300·0	
	11·72	...	1·76	...	
	...	3·56	...	400·0	
	...	...	6·38	500·0	

30 5. Three points, *A*. *B* and *C*, on a seam are determined at elevations of 500, 450 and 300 feet respectively. *A* to *B* is S. 45 degrees W. 200 feet; *B* to *C* is S. 30 degrees E. 180 feet. Find graphically the strike and dip of the seam.

25 6. A dump of waste on a mine is rectangular on a horizontal base and is 300 feet long by 200 feet wide at base. From the apex of it the material has run out on a slope of 35 degrees, equally to the toe of each long side just opposite. Find the cubic contents.

150

SUBJECT: VENTILATION AND DANGEROUS GASES.

Friday, 14th October, 1932: 10 a.m. to 1 p.m.

Possible Marks.

20 1. Given two districts of workings in one mine, each supplied with just sufficient air to prevent the proportion of firedamp in the return from reaching 2 per cent. If, as a result of a new drivage, the return airway of one of the districts was greatly shortened, what would happen in the other district if no precautions were taken to prevent it? What precautions should be taken and how could it be ascertained if they were sufficient?

20 2. State the advantages and disadvantages of splitting air-currents in a mine. Enumerate the causes of inefficient ventilation and how they can be remedied.

20 3. In the lay out of a mine for ventilation, there are 150,000 cubic feet of air per minute available for the purpose. How many ventilating districts could be suitably provided, the output being 1,200 tons per shift?

20 4. When sinking a shaft a seam is reached which is giving off inflammable gas. Men are engaged lining the shaft higher up. State how to ventilate the bottom of the shaft, and prevent the gas accumulating under the cradle. Illustrate your answer by means of a sketch.

20 5. The quantity of air circulating in a mine is 120,000 cubic feet per minute. The horse power of the fan is 80, and the useful effect of the fan is equal to 40 per cent. What should be the height of the water gauge?

20 6. Give the names and properties of the gases usually met with in coal mines, and state their behaviour on lights and life.

20 7. In a mine near the outcrop, naked lights may be used. As the workings advance to the dip, why is the exclusive use of safety lamps necessary?

20 8. There are a pair of headings, one of which is an intake and the other a return airway, and there is a blower of gas at a dyke on the intake heading which is persistent. What should be done to prevent the gas from reaching the working faces?

20 9. State the circumstances which may give rise to the presence of carbon monoxide in a coal mine, and enumerate the principal characteristics of this gas.

20 10. In addition to the ordinary issues of firedamp in colliery workings, there are also "blowers" and "outbursts" of gas. Discuss each of these three issues, explain their origin, and state what precautions should be taken to cope with them.

200

SUBJECT: COAL MINES REGULATION ACT, 1902-1926.

Friday, 14th October, 1932: 2 p.m. to 4 p.m.

Possible Marks.

15. 1. Sections 16 and 17 of the Coal Mines Regulation Act refer to shafts and outlets. Give the substance of these provisions.

15 2. When part of a working mine is found to be dangerous, what action is required before resumption of work is permitted therein?

15. 3. What procedure must be taken for the removal of a check weigher?

15 4. What does the Act require in the following cases:—

(a) Election of check weighman?
(b) Clear space in haulage roads?
(c) Explosives?

15 5. What are the requirements of the Act relative to the construction of safety lamps? When and where should safety lamps be used?
15 6. What precautions must be taken in respect of the abandonment of a mine?
15 7. State the requirements of the Act relative to the employment of boys below ground.
15 8. State the stipulations of the Act concerning the support of roof and sides in working places and roadways.
15 9. State the requirements of the Act regarding fencing of shafts and machinery.
15 10. The Act requires that manholes shall be provided. State the provisions governing the placing of such manholes.

150

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

SUBJECT: ARITHMETIC.

Wednesday, 12th October, 1932: 9 a.m. to 11 a.m.

Possible Marks.

17 1. Calculate the quantity of coal in an area of 500 acres in a seam 6 feet thick and of a specific gravity of 1.280. Make a deduction of 15 per cent. and calculate the total royalty the seam would yield at 6½d. per ton on the remainder.
17 2. What are the contents in cubic feet, the area in square feet, and the perimeter in lineal feet, of a shaft 700 yards deep and 16 feet in diameter?
17 3. A shaft is 20 feet in diameter and 350 feet deep and is filled with water. How long would it take to unwater this shaft with a pump having a capacity of 250 gallons per minute, if the shaft itself is making 50 gallons per minute, and assuming that the pump averages 20 hours effective pumping per day?
17 4. The contract price for boring a hole to a depth of 80 fathoms is 7s. 6d. per fathom for the first five fathoms, and increases at the rate of 7s. 6d. per fathom for each succeeding five fathoms. What is the cost of boring?
16 5. 1,916.464 tons of coal were extracted from a pillar 30 yards by 22 yards by 12 feet high. What percentage was lost in the working, assuming that a cubic foot of coal weighs 80 lbs.?
16 6. Find the length of a circular fence to enclose 12 acres.

100

SUBJECT: COAL MINES REGULATION ACT, 1902-1926.

Wednesday, 12th October, 1932: 11 a.m. to 1 p.m.

Possible Marks

22 1. What are the provisions of the General Rules as regards Coal Mines' ventilation?
20 2. What are the requirements of the General and Special Rules with regard to safety lamps?
22 3. What are the provisions of the Coal Mines Regulation Act with regard to the withdrawal of workmen in case of danger?
20 4. State clearly the requirements of the Act as to plans of workings and abandoned mines.
22 5. Section 16 of the Coal Mines Regulation Act prohibits the use of single shaft tunnels or outlets. Name any exceptions to these provisions.
22 6. Quote the requirements of the General Rules with reference to travelling on haulage roads.
22 7. Quote the rules pertaining to signalling in Coal Mines.

150

SUBJECT: ROADWAYS.

Wednesday, 12th October, 1932: 3 p.m. to 5 p.m.

Possible Marks.

25 1. In a mine operated by an endless rope, there is a section of workings about half a mile inbye and going to the rise from the main tunnel. It is proposed to restart these workings. What method would you adopt to transport the coal to the main rope? The roadway is straight but heavily timbered. How would you arrange for the clipping off and on to the main rope from this district?
25 2. In the use of coal cutting and boring machines in a coal mine, a considerable amount of time is lost and delays occasioned through having to travel on the wheeling roads. Sketch a district and show how this delay can be considerably reduced.
25. 3. Sketch and describe the turns necessary at the clipping stations underground to deal with the coal from the various districts.
25 4. How would you support a haulage road 300 yards long when the sides are good, but when there are five feet of bad roof? The road is to be made 12 feet wide and 6ft. 6ins. in the clear. Give full particulars how to carry out the work.
25 5. A cross measure drift has to be driven 300 yards rising 1 in 5. What mechanical arrangements are necessary in driving, and in the conveyance of the debris, so that work may be done expeditiously and economically?
25 6. It is intended to make an endless rope jig in a place 400 yards long rising 1 in 27. What mechanical arrangements are necessary? Electricity and compressed air are available. Make a sketch, giving full particulars.

150

SUBJECT: MINING OF COAL.

Thursday, 13th October, 1932: 10 a.m. to 1 p.m.

Possible Marks.

29 1. A seam of coal is being worked adjoining an old colliery which is full of water. Give an account of all matters which should be investigated to ensure the safety of the workings.
28. 2. What are the principal matters to which an Under Manager should give his attention on making his ordinary inspection of a mine?
29 3. A section of pillars has been standing for a long time, and as a result all the roadways are heavily fallen. The seam is 8 feet thick with a bad roof. Show and illustrate your answer, with a sketch, how you would re-open the section and extract the pillars.
29 4. A level driven in coal is 10 feet wide and 7 feet high. A dam has to be erected in the level to shut off water under a head of 200 feet. Sketch and describe the type of dam you would erect, giving dimensions.
29 5. You have to tunnel through a heavy and running fall. Describe how you would do so in a drive 10 feet wide and 7 feet high.
29 6. Describe, with sketches, the method of working coal with which you are best acquainted. Show the working face and wheeling roads, and give position of props, bars, and other roof supports.
27 7. It is found that the proportion of large coal being made in a seam under your charge is too low. What reasons can you give for such a state of affairs, and what suggestions can you make to reduce the amount of small coal?

200

SUBJECT: VENTILATION AND DANGEROUS GASES.

Thursday, 13th October, 1932: 2 p.m. to 5 p.m.

Possible Marks.

25 1. Calculate the quantity of air passing in a roadway lined with straight-sided, semi-circular steel arches 10 feet wide by 9 feet high when the velocity is 640 feet per minute. If the same air current passes a place lined with similar arches 9 feet wide by 8 feet high, what is the velocity?

25 2. What provisions are usually made to prevent injury to the fan in the event of an explosion? In case of injury to the fan, what other means of ventilation would you adopt?

25 3. State fully how you would ventilate a single heading expected to reach an ultimate length of 200 yards. Give particulars of all the appliances required, and describe how you would fix and use them.

25 4. What means would you adopt to ensure that a good proportion of the air current produced reached the working faces?

25 5. Sketch an air-crossing. Give details of the material you would use in its construction. To what points would you pay particular attention in order to ensure that the structure is satisfactory?

25 6. Describe briefly, with sketches, a flame safety lamp, paying special attention to the more important parts.

25 7. What, in your opinion, are the best methods of reducing the friction of air in mines?

25 8. Name and describe dangerous gases found in coal mines. How are they formed?

200

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 of State Bateries for the year 1932.

The total tonnage milled and cyanided increased from 100,743¼ in 1931 to 145,961.75 tons, showing increases in tons milled of 16,317¾ and cyanided 28,901. These figures are the highest since 1910 and the tonnage milled is only 16,086¾ less than in the peak year, 1908, and is approximately five times as great as that crushed in 1928.

Grade of Ore.

From the 79,705¼ tons crushed, 48,880.76 ozs. of bullion were recovered by amalgamation, estimated to contain 41,434.06 fine ozs., equal to 10.4 dwts. per ton. The gross contents of the tailing were 14,692.5 ozs. or 3.7 dwt. per ton.

The average value of the ore was 14.1 dwt., worth 59s. 10d., as against 57s. 9d. in 1931—a rise of 2s. 1d. per ton.

The highest grade ore was produced at Bamboo Creek, £6 3s. 1d. per ton, Yarri £4 7s. 1d., Marble Bar £4 0s. 7d., Sandstone £3 18s. 11d., and Ora Banda £3 14s. 11d.

At Peak Hill the 6,101 tons treated yielded ore worth 38s. 5d. per ton and St. Ives produced 3,184 tons worth 27s. per ton. These figures are at par and details are set out in Schedule 3.

Value of Production.

The estimated value of bullion produced by amalgamation and cyanide gold lodged at the Mint is as follows:—

	ozs.		£
Recovery by amalgamation	41,434	worth	175,999·2
Cyanide bullion	11,806·89	,,	50,152·26
Total recovery ...	53,240·89		226,151·46

£35,909·87 premium was actually received on the cyanide gold lodged, equal to 71.6 per cent. Using this figure as the average received by owners for their bullion recovered by amalgamation, the production in Australian currency was—

	£
By amalgamation	302,016
By tailing treatment	85,853
	£387,869

Schedule 2 sets out the tailing production for each battery.

The estimated recovery in Australian currency for 1931 was £224,214.

Revenue and Expenditure. (1931 figures in brackets.)

The working expenditure was £72,913 16s. 2d. (£52,970 4s. 9d.), and revenue received £87,068 16s. 11d. (£51,609 5s. 0d.).

The profit was £14,155 0s. 9d. as against a loss of £1,360 19s. 9d. in 1931.

The revenue for the year includes sundry receipts amounting to £1,501 13s. 1d., which were not earned during the year.

Return to Owners and Estimated Extraction on Ore Treated.

The average value of ore treated was 14.1 dwt. Owners received 10.4 dwt. by amalgamation, equal to 73.67 per cent. of the gross value of the ore.

The whole of the tailing for the year was not treated. By applying the average extraction figure for the period, viz., 78 per cent., to the tailing value of 3.7 dwt. the average recovery is 94.22 per cent., the average residue value being .834 dwt.

The extraction on tailing treatment is lower than usual, but we have discriminated very little as regards refractory material, and have purchased and treated almost the whole of the tailing produced by the 2,117 parcels crushed.

This has been made possible by the higher revenue received on account of the increased price of gold.

The necessity of treating tailing through the winter months so that customers could get the premium without delay has also affected the extraction. However, the gross recovery is slightly over 94 per cent. and may be considered satisfactory.

MILLING.

Exclusive of one 10-stamp and three 5-stamp mills operated by lessees, five 10-stamp and sixteen 5-stamp mills treated auriferous ore for the public and crushed 79,745.75 tons for a yield by amalgamation of 48,404.7 ozs. of bullion of an estimated value of £174,254 at par, or £302,016 with premium.

The number of stamps in operation increased during the year from 120 to 130, and the tonnage by 16,317.5 tons, or 25.7 per cent.

The tonnage crushed was the highest since 1910, and is within striking distance of the peak tonnage of 1908, when 95,628 tons were milled.

Mt. Ida crushed for the first time for some years, and an increased tonnage is expected this year.

The 10-stamp mill at Kalgoorlie commenced operations in April, and to the end of the year had treated 7,712.5 tons.

Most batteries showed improved tonnages and the following crushed over 5,000 tons, the tonnage being shown in brackets: Coolgardie (11,194.25), Kalgoorlie (7,712.5), Ora Banda (6,757.5), Cue (6,374), Peak Hill (6,101), and Meekatharra (5,759.5).

Increased activity was noticeable in the North-West districts, Jimble Bar, Marble Bar, and Bamboo Creek crushing a total of 4,162.5 tons.

Receipts and Expenditure.

Details are at Schedule 6.

The receipts per ton were 9s. 9.04d. and expenditure 12s. 6.36d. as against 9s. 7.9d. and 12s. 8.2d. respectively in 1931.

Heavy expenditure on reconstruction work was charged to our working vote and is reflected in our cost.

The cost of keeping old revived plants like Laverton in constant commission is expensive.

Amongst the larger amounts expended on reconstruction and charged to working was Ora Banda £718 16s. 3d. and Wiluna £415 1s. 5d.

Increased tonnage at Marble Bar and Bamboo Creek, where costs were very high, was responsible for a general increase in expenditure, and it has been found advisable to introduce crude oil power to obviate the high cost of local fuel.

On account of the lack of funds, equipment and spares had been reduced to a dangerous degree and stocks have been built up and are now normal.

A contributing factor in keeping costs at the present level is the cost of water on the Eastern Goldfields.

Water has to be pumped nine miles at Ora Banda, and the charges are 4s. 6d. at Coolgardie and 7s. at Kalgoorlie per 1,000 gallons. These batteries crushed 25,564¼ tons of the total output at all batteries of 79,745.75 tons.

Stamp Duty.

Almost without exception screens with 900 holes to the square inch were used and the duty per stamp was satisfactory. Most of the plants average over 4 tons per stamp per day, the best duties being Jimble Bar 5.59, Ora Banda 5.22, Kalgoorlie 4.86, and Coolgardie 4.58.

Fuel Consumption and Cost per H.P.H.

Steam Plants.

We have only four steam plants in operation and the wood used has been green off the axe and Coolgardie has been the largest consumer. The average consumption was 14lbs. per H.P.H., and cost of running from .77 pence at Coolgardie to 1.14 pence per H.P.H. at Yarri.

Charcoal Producer Plants.

Seven charcoal plants were used and consumption varied according to variety of charcoal used. At St. Ives, where Salmon Gum charcoal was burnt, the consumption was 1.10 lbs. per H.P.H., and at Marble Bar, with charcoal burnt from River Gum, 2.10 lbs. Cost per H.P.H. varied with the quality and price, but was generally good, most plants averaging about 0.5 pence.

Wood Producer Plants.

The most noticeable feature of the year's results was the marked superiority of Salmon Gum over Mulga.

Allowance has to be made for the quality of the wood and the amount of moisture contained, but the three batteries using gum, viz., Kalgoorlie, Ora Banda, and Norseman, consumed under 3½ lbs. per H.P.H. as against 4.41 lbs. of Mulga fuel at Jimble Bar, which had the lowest Mulga consumption.

Costs averaged well under 0.5 pence per H.P.H. with the lowest at Ora Banda, where wood is cheap, the cost being 0.19 pence per H.P.H.

Crude Oil.

At Yalgoo, using a Ronaldson Tippet engine, the consumption of fuel oil was .4 pints per H.P.H., the cost being 0.53 pence. Half the cost of crude oil at Yalgoo is made up of rail freight.

TAILING TREATMENT.

Sixteen tailing plants were in operation. Tailing is not treated at Mt. Ida or Marble Bar, and no treatment was undertaken at Youanme, Yarri or Payne's Find. At these centres there was not sufficient accumulations to warrant the installation of new vats, but Payne's Find and Yarri will operate this year.

66,216 tons were treated during the period for bullion including premium valued at £85,853.

The head value was 4.643 dwt., ranging from 10.54 dwt. at Bamboo Creek to 1.82 dwt. at Peak Hill.

As mentioned in my remarks under "Return to Owners and Estimated Extraction," the percentage recovery was slightly below the previous year's, mostly due to treatment of a large proportion of coppery tailing at Yalgoo, Warriedar and St. Ives, which at one time would have been segregated and possibly not purchased.

Revenue and Expenditure.

For the 66,216 tons treated, revenue amounting to £48,172 19s. 10d. was received, equal to 14s. 6.6d. per ton, and expenditure was £22,923 18s. 4d., or 6s. 11d. per ton. The revenue and expenditure per ton for 1931 were 11s. 2.8d. and 6s. 9.8d. respectively.

Costs ranged from 5s. 4.3d. at Kalgoorlie to 10s. 1.2d. at Bamboo Creek, and whilst we are treating reasonably large tonnages at remote places like Peak Hill, Jimble Bar and Bamboo Creek, there will not be much reduction in the average cost per ton.

£913 was expended from Revenue on additions and equipment, including new vats at Norseman and St. Ives. Cyanide increased in price and additional cost was incurred through treatment in the winter months, when extra labour is required in the preparation of the material. It would be wiser perhaps to increase the capacity of our plants so as to treat only in the summer months, but the delay in the payment of premium to owners would create hardship.

Details of receipts and expenditure are in Schedule 7.

Comparative Synopsis of Results at State Batteries for 12 Months ended 31st December, 1931 and 1932.

	1932.			1931.		
	Tonnage.	Expenditure.	Revenue.	Tonnage.	Expenditure.	Revenue.
Milling	79,745·75	12/6·36	9/9·04	63,428·5	12/8·2	9/7·9
Tailing Treatment ...	66,216	6/11·0	14/6·6	37,315	6/9·8	11/28

Receipts and Expenditure.

	Tonnage.	Expenditure.	Revenue.	Profit.	Loss.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.
Milling	79,745·75	49,963 15 0	38,895 7 1	...	11,068 7 11
Tailing Treatment	66,216	22,923 18 4	48,172 19 10	25,249 1 6	
Tin Treatment	...	26 2 10	0 10 0	...	25 12 10
	145,961·75	72,913 16 2	87,068 16 11	25,249 1 6	11,094 0 9
			Less Loss ...	11,094 0 9	
			Net Profit ...	£14,155 0 9	

ERECTION AND RECONSTRUCTION.

During the year the new 10-head mill at Cue was erected. Sir Samuel and Darlot were put in working order and leased. The capacity of the Coolgardie and Ora Banda tailing plants was increased 50 per cent. and the Kalgoorlie plant equipped and a tailing plant installed with a capacity of 60 tons per day. The old water supply at St. Ives was abandoned and our pumping plant removed to the Victory, a distance of 3 miles from our battery.

The cost of these works was paid from Assistance to Gold Mining Industry and General Loan Fund.

A segregation is as follows:—

	£ s. d.	£ s. d.
Assistance to Gold Mining Industry—		
Wages	1,601 3 6	
Interdepartmental ...	1,453 4 3	
Other	2,198 3 4	
		5,252 11 4
General Loan Fund—		
Wages	1,108 0 0	
Interdepartmental ...	1,455 0 0	
Other	2,328 0 0	
		4,891 0 0
		£10,143 11 4

CARTAGE SUBSIDIES.

Notwithstanding the increased tonnage, cartage subsidies increased only slightly, from £12,995 11s. 4d. in 1931 to £13,265 8s. 7d., of which £3,525 was paid as freight to the railways.

The incidence of our amended regulations is only now being felt, and will make up for the subsidy payments on ore carted to other than State batteries. This concession has been made almost universal during the year.

ADMINISTRATION.

Details of administration are as follow:—

	£ s. d
Salaries	1,452 1 5
Inspection, including Salary of Inspector	1,011 13 7
Insurance	1,665 7 6
Printing	117 2 8
Postage, etc.	24 2 11
	£4,340 8 1

Administration cost per ton increased from 5.03 pence to 7 pence, which is still an excellent figure. The increase is due to the appointment of an inspector and the big increase in insurance from £945 2s. 8d. in 1931 to £1,665 7s. 6d. for the year under review.

STAFF.

The appointment of Mr. L. P. Bisset as Inspector of State Batteries at the beginning of the year was found essential to the proper supervision of the plants.

Notwithstanding the increase in the volume of work, due to the increased tonnages and the payment of premium and gold bonus accounts, the clerical staff was not increased. Considerable assistance was obtained by transferring a large proportion of the orders for stores to the Controller of Stores, and generally the arrangement has been satisfactory.

The Goldfields staff has been increased from thirteen managers and assistant managers to fifteen managers and acting managers, and the services of the two erection officers have also been utilised for relieving work. In addition two assayers and cyaniders have been employed. These officers have supervised the twenty-one plants, carried on a fairly extensive erection programme, and several managers were enabled to take holidays accrued over the busy years.

I take this opportunity of thanking the whole staff for their assistance and congratulating them on the good results.

COST OF ASSISTANCE TO INDUSTRY THROUGH STATE BATTERIES.

	£ s. d.
Cartage Subsidies	13,265 8 7
Erection and Reconstruction	10,143 11 4
	23,408 19 11
Less Profit on Working	14,155 0 9
	£9,253 19 2

GENERAL REMARKS.

At the commencement of the year we were faced with serious congestion at Eastern Goldfields centres and at Cue. With the erection of the 10-head mill

at the latter place and the acquisition of the Kalgoorlie plant, the position is now quite satisfactory and no undue delay occurs in getting ore treated.

Notwithstanding the continued high price for gold and the increased tonnage forthcoming, the grade of ore has increased 2s. 1d. per ton at par, partly due to the larger tonnage of high grade ore treated at North-West plants and the better understanding of ore values arising from added experience of the new-chum prospectors. These men have shown an aptitude for their work that is encouraging; we have a good type of young intelligent prospector at work, and these guided by the older hands should be a distinct asset to the industry.

The reductions in Government employees' wages have had a distinct bearing on the increased profits shown, though the reclassification of Managers' salaries has increased the expenditure on staff. The reduced wages have made it difficult to secure suitable skilled labour, with outside competitors paying higher rates, and at times the position has been critical and our plants have suffered accordingly.

With the increased tonnages and the grouping of batteries for economy, employees have been transferred as much as possible from one plant to another and their employment has been less casual than heretofore.

Some difficulty has been experienced in obtaining qualified men for managerial positions, due to the higher salaries paid outside the service and the increased demand for such man in the industry.

At the time of writing we are fully equipped, and our new officers are showing the results of their experience.

All new plants have shown good results, but some of the very old revived plants still continue to be costly. As far as possible we have discontinued the use of the older type petrol engines for subsidiary pumping, etc., and have installed electrically driven or better class kerosene units. The installation of electrical equipment for lighting purposes, in lieu of acetylene, and for driving water supply pumps was commenced and will be completed this year. With cheap power obtained from producer plants, using local firewood or charcoal to generate the current necessary, increased efficiency and economy can be looked for.

At the beginning of the year our stocks of necessary spares had practically vanished, but, with the better financial position, these have been built up again and are now satisfactory.

Where possible, locally or Australian manufactured plant and stores have been used and prices have remained stationary and quality has been maintained; but with the exception of quicksilver, prices of imported articles have very considerably increased.

All Departmental bullion, amounting to over £85,000 worth, has been sent to the Mint by post, and without this means of realisation the cost of transport would have been very great.

As it is, we find it expensive in many places, where the local post offices make no provision for registered mail, and apart from the necessity of taking long journeys to post Departmental bullion, a large proportion of the prospectors' bullion has to be transported in order to recover our charges. This system of postage has been organised very efficiently by the Deputy Master of the Mint, and every facility is given to owners and amounts due are forwarded promptly and to suit customers.

Another successful year is assured, and at time of writing the tonnage handled is considerably in excess of that handled for the same period last year.

D. F. BROWNE,
Superintendent of State Batteries.
31st May, 1933.

SCHEDULE 1.

Return showing the number of tons crushed, gold yielded by Amalgamation, average per ton in shillings, and total value for year 1932.

Battery.	Tons Crushed.	Gold Yield Bullion.	Value per ton in shillings.		Total Value.
		Fine ozs.			£
Bamboo Creek	1,368·50	1,585·25	83	4·80	5,706·90
Boogardie	4,293·25	2,495·49	41	10·08	8,983·78
Coolgardie	11,194·25	7,453·00	47	11·04	26,830·80
Cue	6,374·00	4,680·10	52	10·08	16,845·84
Darlot	...	...	...	...	...
Jimble Bar	1,160·00	453·85	28	1·92	1,633·86
Kalgoorlie	7,712·50	3,835·35	35	9·60	13,807·26
Laverton	3,426·50	1,446·85	30	4·80	5,208·66
Linden	...	...	...	...	...
Marble Bar	1,574·00	1,706·15	78	0·48	6,142·14
Meekatharra	5,759·50	4,835·22	60	5·28	17,406·79
Mount Ida	665·75	420·00	45	5·04	1,512·00
Mount Keith	...	...	...	...	...
Mount Sir Samuel	...	...	...	...	...
Norseman	4,401·25	2,056·45	33	7·68	7,403·22
Ora Banda	6,757·50	5,353·00	57	0·24	19,270·80
Payne's Find	695·50	464·60	48	0·96	1,672·56
Peak Hill	6,101·00	1,888·40	22	3·36	6,798·24
Sandstone	4,251·00	3,310·30	56	0·72	11,917·08
St. Ives	3,111·00	881·42	20	4·56	3,173·12
Tuckanarra	...	...	...	...	...
Warriedar	3,292·75	970·00	21	2·40	3,492·00
Wiluna	2,871·25	1,042·75	26	1·68	3,753·90
Yarri	1,855·00	1,964·97	76	3·12	7,073·91
Youanmi	80·50	18·85	16	10·32	67·86
Yalgoo	2,800·75	1,542·70	39	7·20	5,553·72
Total	79,745·75	48,404·70	43	8·40	174,254·44

SCHEDULE 2.

Tailing Treatment for 1932.

Battery.	Tonnage.	Yield.	Value.	Premium.
		Fine ozs.	£	£
Bamboo Creek	953	441·59	1,875·43	1,492·53
Boogardie	5,249	1,045·28	4,439·30	3,103·05
Coolgardie	9,852	1,316·81	5,592·49	3,965·11
Cue	5,827	1,360·19	5,776·72	4,112·48
Jimble Bar	1,440	295·50	1,254·98	986·17
Kalgoorlie	2,130	382·00	1,622·35	1,322·88
Laverton	3,580	505·35	2,146·22	1,603·20
Meekatharra	5,797	908·15	3,856·91	2,853·35
Norseman	3,874	596·24	2,532·23	1,782·27
Ora Banda	7,587	1,721·84	7,312·65	4,538·92
Peak Hill	3,837	265·98	1,129·61	875·83
Sandstone	3,474	893·84	3,796·13	2,622·59
St. Ives	3,099	421·95	1,792·02	1,575·85
Warriedar	3,461	711·70	3,022·58	2,323·45
Wiluna	3,996	720·07	3,058·13	2,071·40
Yalgoo	2,195	220·40	936·03	680·79
Total	66,351	11,806·89	50,143·78	35,909·87

SCHEDULE 3.

Return showing Number of Parcels treated and Tons crushed at State Batteries for Year 1932.

No. of Parcels Crushed.	Battery.	Tons Crushed.	Yield by Amalgamation, Bullion.	Yield by Amalgamation, Fine Gold.	Gross Contents of Tailing (excluding refractory tails), Fine Gold.	Total Contents of Ore, Fine Gold.	Average per ton, Fine Gold.	Gross Value per ton.
			ozs. dwt. grs.	ozs. dwt. grs.	ozs. dwt. grs.	ozs. dwt. grs.	dwt. grs.	£ s. d.
29	Bamboo Creek ...	13,68½	1,585 5 0	1,343 14 19	638 0 23	1,981 15 18	28 23	6 3 1
155	Boogardie	4,264½	2,495 9 22	2,115 6 11	935 0 7	3,050 6 18	14 7	3 0 9
367	Coolgardie	11,168¾	7,453 0 1	6,317 11 19	1,930 15 10	8,248 7 5	14 14	3 1 11
119	Cue	6,405¾	4,689 2 12	3,974 15 9	1,522 10 3	5,497 5 12	17 4	3 12 11
15	Jimble Bar ...	1,047	453 17 0	384 14 4	252 0 17	636 14 21	12 4	2 11 8
182	Kalgoorlie	7,712½	3,842 4 0	3,256 17 9	1,307 19 15	4,564 17 0	11 20	2 10 3
130	Laverton	3,426½	1,446 17 2	1,226 7 20	601 0 7	1,827 8 3	10 18	2 5 6
53	Marble Bar ...	1,524	1,706 3 0	1,446 4 12	...	1,446 4 12	18 23	4 0 7
180	Meekatharra ...	5,724½	4,795 4 11	4,064 14 2	1,085 1 7	5,149 15 9	18 0	3 16 6
21	Mt. Ida	665¾	420 0 0	356 0 8	...	356 0 8	10 17	2 5 4
149	Norseman	4,401¼	2,056 9 0	1,743 3 6	856 8 0	2,599 11 6	11 20	2 10 2
120	Ora Banda ...	6,832¼	5,353 0 0	4,537 10 4	1,425 13 15	5,963 3 19	17 11	3 14 1
25	Payne's Find ...	695½	464 12 0	393 16 10	73 8 10	467 4 20	13 10	2 17 0
71	Peak Hill	6,101	2,614 15 0	2,216 8 5	542 12 11	2,759 0 16	9 0	1 18 5
143	Sandstone	4,250½	3,577 0 0	3,032 1 9	915 0 13	3,947 1 22	18 14	3 18 11
49	St. Ives	3,184	783 10 12	664 3 5	350 4 3	1,014 7 8	6 9	1 7 0
68	Warriedar ...	3,307¾	634 8 0	537 15 1	754 16 5	1,292 11 6	7 20	1 13 2
69	Wiluna	2,906¼	1,042 15 0	883 17 21	820 18 3	1,704 16 0	11 18	2 9 10
62	Yarri	1,915	1,928 19 12	1,635 2 4	428 5 23	2,063 8 3	20 12	4 7 1
106	Yalgoo	2,724	1,519 6 12	1,287 17 8	239 1 17	1,526 19 1	11 10	2 7 7
4	Youanmi	80½	18 17 0	15 19 13	13 12 5	29 11 18	7 8	1 11 2
2,117		79,705¼	48,880 15 12	41,434 1 7	14,692 10 2	56,126 11 9	14 2	2 19 10

SCHEDULE 4.

Direct Purchase Tailing, 1932.

Battery.	Tons purchased.	Amount.
		£ s. d.
Bamboo Creek	1,004	1,807 11 4
Boogardie	2,302¾	2,331 7 11
Coolgardie	5,865¾	3,446 11 2
Cue	3,671¾	4,441 11 9
Laverton	3,385¾	1,705 17 9
Jimble Bar	931¼	885 0 0
Kalgoorlie	3,611¼	1,642 12 6
Meekatharra	3,130¼	1,954 11 9
Norseman	2,942½	1,613 13 8
Ora Banda	4,644¾	3,695 5 2
Payne's Find	219½	68 18 1
Peak Hill	1,006¼	549 18 3
Sandstone	2,563½	2,910 0 10
St. Ives	1,983¼	468 14 5
Warriedar	2,938¼	3,062 3 10
Wiluna	3,151¼	3,162 8 1
Yarri	799½	280 13 6
Youanmi	125¼	111 5 2
Yalgoo	991	839 10 6
	45,267½	34,977 15 8

SCHEDULE 5.

Return showing Tailing payable and unpayable and Gross Contents for Year, 1932.

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	1,053¾	628 0 9	105	10 0 14	...	...	1,158¾	638 0 23
Boogardie	2,611	841 7 6	1,011	93 13 1	...	...	3,622	935 0 7
Coolgardie	5,999	1,671 8 9	3,475¼	291 7 1	...	...	9,474¼	1,930 15 10
Cue	4,173	1,416 6 3	1,277¾	106 4 0	...	...	5,450¾	1,522 10 3
Jimble Bar	592¼	239 8 3	104¾	12 12 14	185	no values	697	252 0 17
Kalgoorlie	4,036¼	1,108 9 9	2,510½	199 10 6	...	...	6,546¼	1,307 19 15
Laverton	2,391½	547 17 5	521¼	53 3 2	...	...	2,912¾	601 0 7
Meekatharra...	3,310¼	940 4 20	1,547½	144 15 11	...	...	4,857¾	1,085 1 7
Mt. Ida	...	...	...	...	566¾	138 4 11	....	...
Norseman	2,744¼	773 11 8	992¾	82 16 16	...	...	3,736½	856 8 0
Ora Banda	4,491¾	1,309 11 9	1,275¾	116 2 6	...	...	5,767½	1,425 13 15
Payne's Find	124¾	35 9 20	466¼	37 18 14	...	...	591	73 8 10
Peak Hill	1,125¾	312 9 7	4,054¾	230 3 4	...	...	5,180½	542 12 11
Sandstone	2,441¾	831 8 12	1,169¼	83 12 1	...	...	3,611¼	915 0 13
St. Ives	2,059¼	329 16 1	277¾	20 8 2	369	68 2 12	2,337	350 4 3
Warriedar	2,533½	734 11 16	268¾	20 4 13	...	...	2,802¼	754 16 5
Wiluna	2,196	797 3 17	271¼	23 14 10	...	...	2,467¼	820 18 3
Yalgoo	1,175¾	357 17 10	863¾	70 8 13	274	166 2 0	2,039¼	428 5 23
Yarri	885¼	211 8 7	287½	27 13 10	452½	114 0 21	1,173	239 1 17
Youanmi	60	12 15 5	8½	0 17 0	...	...	68½	13 12 5
Marble Bar	...	...	...	...	1,291	211 9 2	...	...
	44,005¼	13,099 4 8	20,489	1,593 4 18	3,138¼	697 18 22	64,494¼	14,692 9 2

SCHEDULE 6.

Statement of Receipts and Expenditure for Year ended 31st December, 1932.

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.
Bamboo Creek	1,368·5	76 16 0	663 9 3	384 16 5	1,125 1 8	16 5·2	318 18 11	72 13 9	1,516 14 4	22 1·9	725 14 5	10 7·2	...	790 19 11
Boogardie	4,293·25	194 7 10	1,024 13 0	762 10 0	1,981 10 10	9 2·6	264 18 4	232 11 11	2,479 1 1	11 6·4	1,941 5 4	9 0·4	...	537 15 9
Coolgardie	11,194·25	480 10 11	1,804 2 5	2,419 13 11	4,704 7 3	8 4·8	360 19 4	647 16 8	5,713 3 3	10 2·4	5,611 0 11	10 0·0	...	102 2 4
Cue	6,374	265 0 1	1,292 1 5	1,501 0 1	3,058 1 7	9 6·9	329 11 3	297 1 1	3,684 13 11	11 6·7	3,442 17 1	10 9·6	...	241 16 10
Darlot	...	...	...	...	...	...	...	...	...	...	43 9 2	...	43 9 2	...
Jimble Bar	1,160	48 1 11	339 9 10	171 7 11	558 19 8	9 7·4	99 1 10	107 16 8	765 18 2	13 2·4	805 19 0	13 10·5	40 0 10	...
Kalgoorlie	7,712·5	390 19 0	1,428 17 7	1,944 12 6	3,764 9 1	9 9·1	160 9 3	415 11 5	4,340 9 9	11 3	3,233 5 9	8 4·5	...	1,107 4 0
Laverton	3,426·5	264 7 3	1,021 9 6	726 7 2	2,012 3 11	11 8·8	65 6 7	212 2 9	2,289 13 3	13 4·3	1,644 12 10	9 6·9	...	645 0 5
Leonora	...	...	...	...	...	...	...	...	...	...	2 0 0	...	2 0 0	...
Linden	...	...	...	...	...	...	...	...	...	...	27 13 0	...	27 13 0	...
Marble Bar	1,574	74 3 3	579 8 11	574 16 3	1,228 8 5	15 6·9	86 7 4	61 1 5	1,375 17 2	17 5·7	784 14 10	9 11·5	...	591 2 4
Meekatharra	5,759·5	234 18 11	1,446 5 10	1,252 16 0	2,934 0 9	10 2·1	221 1 4	352 3 7	3,507 5 8	12 1·9	2,951 7 2	10 2·8	...	555 18 6
Mt. Ida	665·75	217 9 1	495 3 6	135 8 5	848 1 0	25 5·5	66 1 1	71 7 11	985 10 0	29 7·2	412 7 4	12 4·5	...	573 2 8
Mt. Sir Samuel	...	...	...	...	...	...	...	...	...	...	33 6 10	...	33 6 10	...
Mulline	...	...	...	...	...	...	...	...	...	...	5 0 0	...	5 0 0	...
Norseman	4,401·25	324 15 3	1,306 10 3	943 12 4	2,574 17 10	11 8·4	175 9 3	290 6 4	3,040 13 5	13 9·6	2,274 19 2	10 3·8	...	765 14 3
Ora Banda	6,757·5	194 0 10	1,749 9 2	768 6 6	2,711 16 6	8 0·2	718 16 3	333 3 11	3,763 16 8	11 1·6	2,755 4 7	8 8·8	...	1,008 12 1
Payne's Find	695·5	79 10 1	268 0 6	390 12 0	738 2 7	21 2·4	154 10 2	36 0 4	928 13 1	26 7·2	362 8 6	8 11·7	...	566 4 7
Peak Hill	6,101	216 8 10	1,481 10 7	823 1 11	2,521 1 4	8 3·1	247 2 1	276 8 9	3,044 12 2	9 11·7	2,605 13 8	8 6·4	...	438 18 6
Pingin	...	...	...	...	...	...	...	...	...	...	10 0 0	...	10 0 0	...
Sandstone	4,251	278 2 10	1,338 15 5	606 4 11	2,223 3 2	10 5·2	236 3 8	213 0 10	2,672 7 8	12 6·7	2,028 12 0	9 6·4	...	643 15 8
St. Ives	3,111	201 8 5	1,009 10 3	764 15 4	1,975 14 0	12 8·4	343 17 1	181 7 7	2,500 18 8	16 0·7	1,667 16 8	10 8·6	...	833 2 0
Tuckanarra	...	...	...	...	...	...	...	20 0 0	20 0 0	...	38 14 0	...	18 14 0	...
Warriedar	3,292·75	321 5 8	858 4 7	588 11 5	1,768 1 8	10 8·8	355 7 6	263 15 11	2,387 5 1	14 5·7	1,451 11 8	8 9·6	...	935 13 5
Wiluna	2,871·25	195 16 4	607 3 1	438 9 7	1,241 9 0	8 7·2	415 1 5	200 9 2	1,856 19 7	12 11	1,511 17 1	10 6·2	...	345 2 6
Yarri	1,855	130 10 3	658 3 9	369 16 9	1,158 10 9	12 5·7	4 16 0	79 12 4	1,242 19 1	13 4·5	1,095 14 11	11 9·6	...	147 4 2
Youanmi	80·5	14 0 0	79 13 6	22 6 9	116 0 3	28 9·6	9 2 5	22 19 0	148 1 8	16 9·3	59 15 0	14 10	...	88 6 8
Yalgoo	2,800·75	260 3 1	762 2 10	400 14 1	1,423 0 0	10 1·9	129 5 8	146 15 8	1,699 1 4	12 1·4	1,366 10 3	9 9·1	...	332 11 1
Sandy Creek	...	...	...	...	...	...	...	...	...	...	1 15 11	...	1 15 11	...
	79,745·75	4,462 15 10	20,214 5 2	15,990 0 3	40,667 1 3	10 2·4	4,762 6 9	4,534 7 0	49,963 15 0	12 6·4	38,895 7 1	9 9	181 19 9	11,250 7 8
Tin Plant—Greenbushes ...	...	...	26 2 10	...	26 2 10	...	...	...	26 2 10	...	0 10 0	...	...	25 12 10
	...	...	20,240 8 0	...	40.693 4 1	...	...	...	49,989 17 10	...	38,895 17 1	...	...	11,276 0 6

SCHEDULE 7.

Statement of Receipts and Expenditure for Year ended 31st December, 1932.

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.	s. d.	£ s. d.	£ s. d.
Bamboo Creek	953	38 8 1	223 12 9	31 18 4	130 4 0	424 3 2	8 7·9	19 2 6	38 9 7	481 15 3	10 1·2	1,453 3 3	30 5·7	971 8 0	...
Boogardie	5,249	125 5 9	772 7 11	112 8 9	422 8 0	1,432 10 5	5 5·2	97 7 0	177 17 4	1,707 14 9	6 6	3,401 11 11	12 11·5	1,693 17 2	...
Coolgardie	9,852	179 1 4	1,878 16 9	119 10 0	668 8 3	2,845 16 4	5 9·1	61 9 6	338 2 0	3,245 7 10	6 6·9	5,622 13 1	11 4·8	2,377 5 3	...
Cue	5,827	140 14 8	886 7 3	181 5 8	428 5 7	1,636 13 2	5 7·2	23 0 6	229 16 7	1,889 10 3	6 5·7	5,362 10 8	18 4·8	3,473 0 5	...
Jimble Bar	1,440	126 19 8	325 11 0	32 18 9	149 4 2	634 13 7	8 9·6	3 13 4	49 7 7	687 14 6	9 6·4	1,369 17 0	19 0·2	682 2 6	...
Laverton	3,580	127 16 2	548 16 9	101 1 8	585 5 10	1,363 0 5	7 7·2	6 2 2	110 1 1	1,479 3 8	8 3·1	2,039 7 10	11 4·5	560 4 2	...
Meekatharra	5,797	101 1 7	1,048 17 7	110 4 11	329 0 8	1,589 4 9	5 5·7	59 15 7	190 19 4	1,839 19 8	6 4	3,982 13 2	13 8·6	2,142 13 6	...
Norseman	3,874	108 6 9	518 13 11	72 4 7	309 7 4	1,008 12 7	5 2·4	233 12 1	176 14 5	1,418 19 1	7 3·8	2,249 12 1	11 7·2	830 13 0	...
Ora Banda	7,587	223 0 5	1,405 1 10	74 6 6	544 16 7	2,247 5 4	5 11	75 4 0	250 9 6	2,572 18 10	6 9·3	5,403 18 2	14 2·8	2,830 19 4	...
Peak Hill	3,837	90 10 0	701 13 11	57 1 5	240 18 4	1,090 3 8	5 8·1	11 0 5	106 19 0	1,208 3 1	6 3·3	1,339 9 5	6 11·7	131 6 4	...
Sandstone	3,474	41 12 9	632 17 0	63 12 6	346 7 0	1,084 9 3	6 2·8	9 0 0	145 8 3	1,238 17 6	7 1·4	3,282 10 4	18 10·5	2,043 12 10	...
St. Ives	2,964	105 6 8	421 18 6	102 2 9	351 3 2	980 11 1	6 7·2	178 13 3	109 16 8	1,269 1 0	8 6·7	1,811 9 4	12 2·6	542 8 4	...
Warriedar	3,461	44 17 1	542 16 1	161 2 2	278 17 10	1,027 13 2	5 11	70 9 5	124 6 10	1,222 9 5	7 0·7	2,186 2 1	12 7·4	963 12 8	...
Wiluna	3,996	121 17 9	760 8 11	72 6 11	341 14 5	1,296 8 0	6 5·7	46 7 2	109 7 0	1,452 2 2	7 3·1	2,389 8 10	11 11·2	937 6 8	...
Yalgoo	2,195	34 7 7	344 11 4	48 15 9	138 16 0	566 10 8	5 1·9	...	60 11 10	627 2 6	5 8·4	908 6 2	8 3·1	281 3 8	...
Kalgoorlie	2,130	36 0 0	269 0 0	33 12 2	134 0 8	472 12 10	4 5	18 4 0	71 8 11	562 5 9	5 4·3	1,838 6 8	17 3·1	1,276 0 11	...
Yarri	...	6 10 6	...	9 6 9	3 12 8	19 9 11	...	...	1 3 2	20 13 1	...	30 6 9	...	9 13 8	...
Revenue Suspense Account	...	...	...	...	...	...	...	...	...	...	...	3,501 13 1	...	3,501 13 1	...
	66,216	1,651 16 9	11,281 11 6	1,383 19 7	5,402 10 6	19,719 18 4	5 11·2	913 0 11	2,290 19 1	22,923 18 4	6 11	48,172 19 10	14 6·6	25,249 1 6	...

Annual Progress Report of the Geological Survey of Western Australia for the year 1932.

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DIVISION IV.

Annual Progress Report of the Geological Survey for the Year 1932.

Under Secretary for Mines.

I have the honour to submit to you, for the information of the Hon. the Minister for Mines, my report on the work of the Geological Survey for the year 1932.

STAFF.

The personnel of the staff remained unchanged during the year under review, and still remains at two field officers, one technical assistant, and a messenger.

FIELD WORK.

Government Geologist.—During the year, in addition to the ordinary routine work, I was absent on 11 occasions making field inspections. As these inspections were made mainly for departmental information, the reports are not submitted for publication, but for reference purposes are listed as follows:—

1. Inspection of Gold Prospecting Areas at Yiniding Creek, Toodyay District.
2. Inspection of New Gold Finds on Edwards' Farming Area 450, nine miles south-west of Cockatoo Tank; also Reynolds' Find, Block 58, lying some ten miles north-east of Bullfinch, Yilgarn Goldfield.
3. Inspection of O.P.A. 236H with regard to a sample of Stinkstone (Stinkstein) found in a Lime Deposit on Boolardy Station, Murchison District.
4. Inspection of the Water Supply for Mining Treatment Purposes at Ora Banda, Broad Arrow Goldfield.
5. A Second Inspection of the Mines in the Ora Banda District, Broad Arrow Goldfield.
6. Inspection of the Paringa Gold Mine, Kalgoorlie.
7. Inspection of Cameron and Paulson's Gold Mine on Mt. Stuart Station (Wyloo), Ashburton Goldfield.
8. Inspection of the State Battery, Ravensthorpe, including Inventory of the Copper Separation Plant and Inspection of Ore purchased for the Ravensthorpe Smelters.
9. Collecting further evidence for Dr. Herman, including the Revision of the Collie Map and Sections.
10. Inspection of the Boring at Lancefield, Mt. Margaret Goldfield.
11. Inspection of the Reported Find of Mineral Oil at Yarloop, South-West Division.

The number of enquiries for geological information, particularly regarding gold mines, and the demand for bulletins and maps is still maintained, and if the present demand for publications continues several of our much sought-for bulletins will be completely out of print.

F. R. Feldtmann, Field Geologist.—During my absence on leave in the early part of the year, Mr. Feldtmann dealt with the more important enquiries from the public and with a few cases on proposed alienation of lands.

The far greater portion of his time was taken up in preparing maps and a written report on the western portion of the Golden Mile. This report is now nearly completed.

F. G. Forman, B.Sc., Assistant Geologist.—From the 19th-28th April Mr. Forman accompanied me on a reconnaissance of O.P.A. 236H. From the 12th September-10th November, he carried out a reconnaissance survey of O.P.A. 235H and parts of adjoining O.P.As. to the south. From 13th-21st December he was engaged in inspection work at Mt. Magnet and Boogardie.

The remainder of Mr. Forman's time was taken up in the office. His report on the Warburton Range Area was completed about the middle of August, the delay in its completion being due to the difficulty in obtaining the service of a petrologist to carry out certain sections of the enquiry. Apart from the time taken up in writing reports on his other field work, Mr. Forman also assisted with the assembling of the collection of minerals and ores, now on exhibit in the main hall at the Mines Department, and with the re-arranging of the Departmental Library.

CLERICAL WORK.

F. Armstrong, B.Sc., Technical Assistant.—In addition to the ordinary routine work and interviewing the general public, Miss Armstrong has this year assisted with the assembling of the Mineral Exhibits at the Mines Department and at the Royal Show.

The work of cataloguing, by cross reference, the articles in both current and back numbers of the publications dealing with Australian Geology has been continued; also the cross-indexing of the rock and mineral collection. In addition, the Library has been re-arranged.

To assist those searching for maps and reports published in bulletin form, Miss Armstrong has compiled a wall map of the State indicating in colour the area or centre described in each bulletin with the number of that bulletin clearly marked, so that the particular bulletin dealing with any part of the State can be seen at a glance. It has been so arranged that where an area or part of one is reported on in more than one bulletin, each has a distinguishing colour and its number.

A similar map showing the localities for reports published in the Annual Progress Report is nearing completion.

PETROLOGICAL WORK.

With the exception of the special case of the rocks from the Warburton Range Area, which were reported on by Mr. R. W. Fletcher, B.Sc., the remainder of the determinations was carried out by Miss Armstrong.

The summary of Mr. Fletcher's report is attached hereto, and it is to be hoped that later on Mr. Forman's full report with the petrology will be published in bulletin form.

PALAEONTOLOGICAL WORK.

As in former years, we have been again indebted to Miss L. Hosking, B.A., of the Department of Geology of the University of W.A., who has gratuitously made determinations of any specimens collected in the field from various localities throughout the State.

The reports or summaries of the work done in the field by the members of the staff, except when written for departmental purposes only, are attached hereto.

In conclusion, I take this opportunity to express my appreciation of the work and loyal support of the members of the staff during the past year.

T. BLATCHFORD,
Government Geologist.

16th March, 1933.

1.—CONCLUSIONS OF REPORT ON A RECONNAISSANCE SURVEY OF THE COUNTRY LYING BETWEEN LAVERTON AND THE WARBURTON RANGES.

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

That part of the country between Thatcher's Soak, near Mt. Shenton, and the junction of Hughes and Elder Creeks, near the Warburton Range, is occupied by sediments of the Wilkinson Range Series, except for a small patch of highly metamorphosed rocks, which outcrop in the vicinity of Minnie Creek, about sixteen miles east of Mt. Shenton.

The area in the Warburton Range District described in G.S.W.A. Bulletin 75 as being occupied by greenstones, which were considered to be the equivalent of the greenstones of the Western Australian Goldfields and therefore to be placed in the Kalgoorlie Series, is now shown to be occupied by a series of metamorphosed sediments and interbedded basaltic flows or sills which it is believed can be correlated with the Nullagine formation.

This series has been named the Townsend Range Series because the series of that name, described in Bulletin 75, constitutes the upper portion of the formation as now mapped.

The sedimentary portion of the series consists of conglomerates, grits, quartzites, sandstones and shales, which exhibit various degrees of metamorphism from entirely recrystallised and chloritised rocks to others which are almost unaltered.

The basic rocks occur as flows or sills interbedded with the sediments. The basalts are of three types—spilites, greenstones, and epidosites—which are intimately associated and are considered by Mr. R. W. Fletcher, B.Sc., who undertook the petrological work in connection with the recent investigation, to represent different phases of the one magma. Spilites from the vicinity of the Charnley and Isdell Rivers and epidosites from Synnott Creek in the Kimberley Division are remarkably like some of the Warburton Range spilites and epidosites. These rocks from the Kimberley occur as flows or sills interbedded with sediments, and are probably of Nullagine age.

The porphyries, which occupy a considerable part of the Warburton Range area are now regarded as sills intercalated with the metamorphosed sediments and basalts of the Townsend Range series. Almost similar rocks occur as sills in the Nullagine formation at Bamboo, Pilbara Goldfield.

The Townsend Range series, subsequent to the intrusion of the porphyry sills, has been thrown into a series of broad folds along axes with a general east-west trend.

Micropegmatites and granites in the vicinity of Mt. Squires are considered to be co-magmatic with the sill porphyries, and are mineralogically dissimilar to the older granulites and granites which border the Townsend Range series on the north and extend eastward towards the South Australian border.

From the conclusions reached in Bulletin 75 that the "Greenstone" areas in the vicinity of the Warburton Ranges probably belong to the Kalgoorlie Series, the hope was justified that payable gold deposits might ultimately be found within these areas. The conclusions reached in the present investigation considerably reduce the economic mineral possibilities of the area, as no large gold-bearing lodes or reefs have yet been discovered in rocks of the Nullagine formation in any part of the State. There is an undoubted possibility of finding gold in the conglomerates of the Townsend Range series, but deposits of this character would be almost certainly of low grade and quite unworkable for many years to come in such a remote region as the Warburton Ranges.

The possibilities of the discovery of deposits of copper, lead, or other economic minerals are no brighter, and on the present evidence the Warburton Range area cannot be regarded with favour as a potential mineral field.

WATER HOLES AND SOAKS BETWEEN THATCHER'S SOAK AND ELDER CREEK.

Thatcher's Soak at the starting point of the traverse is a stoned and covered well. It has been known to dry up in severe seasons.

Bhildbit Soak at PB.16 is a large soak in the bed of a small creek tributary to Minnie Creek. It is apparently of a permanent character.

At PB.17 there is a large pool in Minnie Creek from which a copious supply of water was available when seen by us. It was, however, rapidly drying up when seen on the return journey, and, like the many other pools in Minnie Creek, would be useless except for a few months after heavy rains.

Eurothurra rock hole at PB.41 is a gnamma hole of about 200 gallons capacity situated on a low stony rise to the south of the track.

Beegul rock holes consist of two holes in the bed of a small watercourse at the top of a breakaway cliff on the south side of the track. Their position is marked by two caves in the low cliff of the breakaways in which are many aboriginal drawings. The total capacity of these holes is probably 400 gallons.

Gnamal rock holes at PB.55 are marked by a sharp northward turn in the track over a low gravelly rise. Their capacity when full is about 250 gallons.

At PB.75 water is obtainable at a depth of 2ft. 6in. in lake country.

Buldya Soak at PB.84 yields a good supply of potable water. On being cleaned out and slightly deepened water entered as springs from the sandstone bottom. If timbered and deepened a very good supply would be obtainable.

Nullye Soak at PB.95 is situated in the bed of a shallow watercourse flowing from the north and crossing the track. The soak or water hole is about five chains up the creek.

Tugaila gnamma hole at PB.101 consists of two holes with a total capacity of about 200 gallons, situated near the base of a gravelly rise on the east side of a wide grassy flat and thirty chains north of the track.

Terhan gnamma hole at PB.117 has a capacity of 200 gallons and is situated on a low gravelly rise in the middle of a wide flat.

Babool gnamma holes at PB.131 consist of two large holes with a capacity of about 700 gallons. These holes are on a laterite rise in a patch of mulga on the western edge of a long stretch of sandhill country. The holes are situated on the north side of the track just before it passes into the sandhill country to the east.

Whalgu gnamma holes at PB.143 have a capacity of about 300 gallons and situated at the base of a breakaway facing the east and on the south side of the track.

Muggan gnamma hole at PB.153 is situated on the south side of the track, where it makes a sharp turn to pass over a gravelly rise.

Narratha rock holes at P.B.158 consist of several gnamma holes, lying along the edge of a westerly facing breakaway. They are marked by a wide flat on the north of the track and ending abruptly against the breakaway cliffs. The two larger holes have a capacity of from 300 to 400 gallons.

Manunda rock hole at PB.177 is situated at the base of an isolated patch of breakaway country and at its eastern end.

Yowalga rock holes at PB.181 consist of two gnamma holes with a total capacity of about 400 gallons and situated on a low gravelly ridge bordering the track.

At PB.195 the track crosses a dry watercourse in a north-south trending valley. A little water is obtainable here by digging in the sandy bed of the dry creek.

Gahnda rock hole is situated in a watercourse near the top of a breakaway ridge immediately to the east of the wide valley just mentioned. When seen by us it held about 1,000 gallons of water, but if cleaned out would hold at least 10,000 gallons when full.

Winduldarra rock hole at PB.210 has a capacity of about 1,000 gallons and is situated in a watercourse trending westerly out of breakaway cliffs, about ten chains to the north of the track, where it gains the top of the breakaway ridge.

Babbagoola gnamma holes at PB.223 have a total capacity of about 400 gallons and lie about five chains to the south side of the track, where it takes a sharp northerly turn to gain the crest of a breakaway ridge.

Gnawlbat at PB.226. By digging in the sandy bed of the creek where it passes through a narrow gap between the breakaways on either side, a good supply of water is obtainable.

At PB.235 are the Weeljarra rock holes. These are three in number and have a total capacity of perhaps 300 gallons. They are situated to the north of the track on the edge of an easterly facing breakaway.

Korndiggurra gnamma holes, two in number with a total capacity of about 100 gallons, are situated right on the track at PB.236.

Milesia well at the junction of Hughes and Elder Creeks at PB.256 is in the bed of Elder Creek and appears to be permanent.

Few of the above-mentioned waters could be relied on to be serviceable at the end of the dry season, as the rock holes without exception were very low on our return journey at the end of September, 1931. It must be admitted, however, that the holes had been used by four parties during the season, so that they were heavily drawn on. Offset against this is the fact that at the beginning of the season all the holes were filled following on the exceptionally good rains. The large hole at Ghanda may possibly be permanent.

Of the soaks only those at Bhildbit and Buldhya appear to be of a really permanent character. The wells at Thatcher's Soak and Milesia may also be classed as permanent in ordinary seasons.

WATER HOLES AND SOAKS IN THE WARBURTON RANGE AREA.

At the junction of Warburton Creek and Elder Creek at the west end of the Warburton Range there are two soaks in the bed of the larger creek.

Gombugurra well is a native well in the bed of Elder Creek three miles north of the Warburton Ranges.

About a mile above where Scamp Creek comes out from amongst a mass of rough granite hills, and ten miles north of the Warburton Ranges, there is a small rock hole about sixty chains up a small tributary watercourse on the right bank of Scamp Creek. The junction of this watercourse with Scamp Creek is marked by a tree blazed P.B. 273.

At Spring Granite (Beelorro-Coonabaroo), discovered by Sir John Forrest in 1874, there is a large rock hole on the east side of a bare granite outcrop. This hole would hold water for a long time.

A similar rock hole on a granite outcrop lies two miles eastsoutheast of Spring Granite. It is known to the natives as Windarro, and should hold water for a long time.

In the bed of Hughes Creek, about six and a-half miles above its junction with Elder Creek and close to a rocky hill on the right bank, there is a native well which would require cleaning out before being of much use.

On the southern side of the chain of hills joining Cassidy Hill and Mt. Herbert, and two and a-half miles east of Cassidy Hill, there is a soak (Gamminah) in the bed of a small watercourse, which yields a good supply when dug out.

In the bed of Lilian Creek, about half a mile above where it passes through the gap in the Townsend Range, there is a native well (Choogidda), which yields a copious supply of water.

Weelgryne Spring is situated in a rough and deep gully, difficult of access for camels, on the southeastern slope of Mt. Eveline. The spring is about twenty chains above where the watercourse enters the flats.

Nundull rock hole is about one mile west of Mt. Esmé in a small rocky watercourse on the southern slope of a porphyry hill. There is a larger and much broader gully immediately to the east, between the rock hole and Mt. Esmé. This soak was almost dry when visited by our party.

A good rock hole (Brelyalee) with some soakage is situated at the eastern end of a line of rocky hills about two miles east of Mt. Elvire.

At Barlee Springs there is a good soakage in the bed of a sandy creek flowing southwesterly from a

mass of rough porphyry hills. The soak is situated just below the point where the creek issues from a low rocky gorge. This soak is capable of being deepened and appears to be reliable.

Meewajarra soak lies about two and a half miles southwest of Cairn H.P. 41 on the western side of the Barrow Range, opposite a wide gap at about the middle of its length.

Winburn Rocks gnamma hole lies on the eastern side of the Barrow Range, about six miles east of the Cairn H.P. 41.

Bilbring rock hole lies at the base of a bare granite outcrop about thirty-five chains south of the Cairn H.P. 42 on Lightning Rock.

Of the above-mentioned waters only the rock holes at Spring Granite, Windarro and Brelyalee, and the soaks at Choogidda, Gamminah, Weelgryne and Barlee Spring can be considered as possibly of a permanent character.

2.—SUMMARY OF THE PETROLOGICAL REPORT ON THE ROCKS FROM THE WARBURTON RANGE AREA.

(R. W. Fletcher, B.Sc.)

The Warburton Range Area consists of a folded series of fragmental rocks, comprising shales, mudstones, sandstones, grits and conglomerates, with intercalated acid and basic flows and sills which have in places completely metamorphosed the sediments.

The basic sill or flow rocks include three important types which outcrop repeatedly, due to folding, throughout the area. These are the Spilite (abitised basalt), Greenstone (chloritised basalt), and Epidosite (epidotised basalt) types respectively. Certain rocks, described under the heading "Miscellaneous Rocks," represent single limbs of folded flows or sills outcropping south of the Warburton Range only.

The three principal types are characterised by amygdaloidal structure which is particularly well-marked in the spilites and epidosites. The greenstones are coarser in grain and less amygdaloidal, so that they appear to represent the more central portions of flows or sills. All three are similar to each other in micro-texture and mineralogical constitution but they differ in mineral proportions. The principal minerals are albite, chlorite, epidote, amphibole, iron ore, leucoxene, calcite and quartz. In the spilites, albite, iron ore and leucoxene are very abundant, while chlorite, epidote, calcite and quartz are more frequently found as amygdules; in the greenstones, chlorite, amphibole and epidote are the common minerals; and in the epidosites, epidote is far in excess of the other constituents. All three types have well-defined plexal fabrics, the laths consisting principally of albite (in the spilites), chlorite (in the greenstones) and epidote (in the epidosites).

In view of the field association, and the general similarity in structure, micro-texture and mineralogical constitution, it is considered that the three types represent phases of the same magma. The differentiation was probably caused through circulating solutions and gases during the final stages of consolidation.

An attempt has been made to correlate these basic rocks with similar rock types from other parts of Western Australia and sufficient evidence obtained to prove definitely that the Warburton Range rocks are more closely allied to the basic flows and sills of the Nullagine formation in the Kimberley and North-West Divisions, than to any other known rock series in Western Australia.

The acid sill rocks include a variety of porphyries such as felspar-porphyry, quartz-felspar-porphyry, granite-porphyry, granophyric-porphyry and biotite-rich-porphyry. It is impossible to determine petrographically whether these types are all phases of the one sill or whether they represent several different sills, for they are all more or less similar in composition. The principal differences, those of texture and structure, are due to different rates of cooling, and to different degrees of mechanical deformation which occurred during the final stages of crystallisation. The minerals of the porphyries belong to three stages of development, the phenocryst stage (quartz, alkalic felspar, iron ore and green mica), the groundmass stage (quartz, alkalic felspar, micas and iron ore), and the hydrothermal-pneumatolytic stage (quartz, biotite, epidotes, calcite, fluorite, tourmaline and pyrite).

The rocks described by Farquharson as "dyke porphyries" belong to this group of acid sill rocks, but I can find no relationship between the so-called granular-porphyries (which are really metamorphic rocks) and the true porphyries. The "granular porphyries" are, however, related to the partially metamorphosed (recrystallised) granite outcropping in the north of the area, in the vicinities of Bentley Hill, Spring Granite and Gneiss Hill, and it seems evident from the general metamorphic character of these acid rocks, that they belong to some earlier period of igneous intrusion. On the other hand the accessory-rich granite in the vicinity of Mt. Squires is very similar in mineralogical constitution to the sill porphyries, and there can be no doubt that this granite and the porphyries are co-magmatic and are of the same age, the granite being probably the feeder of the porphyry sills.

An analysis of one of the porphyries agrees very closely with that of (5404), described as an acidic (felsite) lava, from the Nullagine formation in the North-West Division. Incidentally, Mr. Forman observed, independently, the similarity in the hand specimens of this rock (5404) and some of the Warburton Range porphyries.

In addition to the acid and basic rocks of sill and flow origin, there are, in the northern part of the area, numerous dykes of epidorite and dolerite, which may be related, on one hand to the basic flows and sills of the Warburton Range Area, and, on the other hand, to the ultrabasic plutonic mass of the Cavanagh Range. It is suggested, on very slender evidence, that the three groups, corresponding to the three phases of igneous activity, plutonic, hypabyssal and extrusive, may be co-magmatic.

The sedimentary rocks include shales, mudstones, sandstones, grits and conglomerates, some of which have undergone partial, or almost complete, metasomatic changes. The principal molecules introduced during the metasomatism were lime and silica. In the vicinity of the slowly cooled porphyries rich in minerals belonging to the hydrothermal-pneumatolytic stage of crystallisation, the sediments have been completely recrystallised and new mineral assemblages formed. However, in both the metamorphosed and un-metamorphosed sediments, tourmaline has developed as a result of the pneumatolytic action connected with the final stage of crystallisation of the porphyries. There is fairly strong evidence to show that the meta-sediments are the metamorphic representatives of the normal fragmental rocks.

Correlative evidence indicates that the Warburton Range assemblages of acid and basic flows and sills and interbedded sediments, belong to the Nullagine formation.

3.—SUMMARY OF A REPORT ON A SAMPLE OF STINKSTONE (STINKSTEIN) FOUND IN A LIME DEPOSIT ON BOOLARDY STATION, MURCHISON DISTRICT.

(T. Blatchford, B.A., and F. G. Forman, B.Sc.)

From the inspection carried out in the field and from information otherwise obtained, we have arrived at the following conclusions:—

1. Most of O.P.A. 236H is occupied by granite on which may be shallow surface deposits, but deep basins would be most unlikely.
2. The stinkstone is not confined to the spot where it was first found, but was located in four other places by us, so it is probably fairly common.
3. Where found it was evident that the stinkstone was definitely a variety of travertine limestone, usually the darker variety, occasionally the yellow, but never the really white.
4. The stinkstone does not occur in a regular limestone bed similar to oil-bearing limestones in other countries, but is a surface deposit.
5. Confirming field evidence, analyses of the samples collected show no signs of petroleum.
6. In our opinion, therefore, the occurrence of stinkstone at Boolardy Station has no bearing whatever on the possible occurrence of mineral oil in that area.

4.—FINAL REPORT ON THE CORRELATION OF THE ARTESIAN BORES IN THE METROPOLITAN AREA, PERTH.

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

Investigation shows that the information available is insufficient and of too doubtful a character to be used in the production of an accurate sub-surface contour map, indicating the depth below the surface of the various artesian water beds.

The reasons for this conclusion are as follows:—

1. The majority of the bore records available depend on drillers' logs only for a description of the strata passed through. A comparison of the drillers' logs with determination of the strata made by officers of the Geological Survey in the few instances where the cores have been examined by them, shows the drillers' determinations to be often much in error and of very doubtful value.
2. In those cases where sections of the cores have been preserved, there are insufficient samples to allow of these cores being used for accurate correlative purposes.
3. There is great uncertainty in many of the boring records as to the exact depth at which the flows began, in many instances there being in the record simply a note of the amount of flow in gallons per day at a particular depth, the depth at which the flow started being omitted.
4. It has been the custom to record the temperature of the water and its static head only after completion of the bores so that these records for correlative purposes are of doubtful value. The same applies to water analyses.
5. On a study of the bore logs in the Claremont District, it appears that the strata are displaced between the Claremont No. 1 and No. 2 Bores. Lack of information as to the direction and amount of throw of this fault and the possibility of faulting in other parts of the Metropolitan Area make any sub-surface contour plan, drawn without more information than is at present available, of very doubtful value.

The following conclusion have been reached as the result of this investigation:—

The base of the coastal limestone series, consisting of current bedded calcareous sandstones, lies at elevations varying from sea-level to as much as 180 feet below sea-level in different parts of the Metropolitan Area.

Underlying the coastal limestone series there are lacustrine deposits of soft calcareous shales and sandstones passing downwards into a series of marine beds of calcareous shales or mudstones, sandstones and impure limestones. All the beds present are extremely lenticular.

Under the Metropolitan Area there are three distinct artesian water-bearing horizons. These horizons can be distinguished by water analyses, static heads and temperatures of the various flows. The horizons when contoured from bore to bore are found to be unconformable and it is suggested that the water-bearing horizons lie on the surfaces of the unconformities, because of the frequent occurrence of extremely coarse sands and small boulders in the water-bearing zones. These sands are in distinct contrast to the fine-grained nature of the other sediments throughout the series.

Of the three horizons, the upper two have a limited distribution. The upper horizon is met with in the bores in the vicinity of the city and at Osborne Park, and it is thought that the bores of the Guildford District also draw their water from this horizon. The second horizon is met with in the bores in the Leederville District and in the King's Park bores on Mount's Bay Road. The third horizon covers a larger area, having been encountered in all bores of sufficient depth.

In the attached table the various bores in the Metropolitan area have been divided into groups according to which horizon each bore derives its main supplies of water. In the case of those bores which draw by separate casings from two horizons, the separate flows have been listed in their respective groups. Details, where available, of water analyses, temperatures and static heads are also shown.

Three main artesian water horizons can be recognised and these have been named, for purposes of reference, according to the district in which each horizon has been chiefly exploited by boring. As will be seen from the table, these are the Claremont-South Perth, the Leederville and the City horizons, which occur in that order from the lowest upwards. Owing to the relatively isolated positions of the bores at Fremantle, Guildford and Midland Junction from the remainder of the bores in the Metropolitan Area these have not been correlated, as it is considered that too great an uncertainty exists to allow of this being done.

The following facts stand out clearly from the table. The waters from the Claremont-South Perth and the Leederville horizons have a carbonate content varying from 10.6 to 15.8 grains per gallon. This is in distinct contrast to the carbonate content of waters from the City horizon, which varies from 4.6 to 7.2 grains per gallon.

It will be noticed also that in the case of the two lower horizons the chloride content of the waters is generally higher than that of waters from the City horizon, although in this case there is not the same marked difference as shown by the carbonate content.

The temperatures of the various waters show a definite variation from one horizon to another. In the Claremont-South Perth horizon the temperature varies from 100deg. to 105deg. F.*, in the Leederville horizon from 88deg. to 95deg. F., and in the City horizon from 75deg. to 81deg. F. This association of definite temperature groups with the several water horizons is probably only of a casual nature as the temperature of the water should be, and probably is, a function of the depth of the aquifer below the surface.

The last column in the table shows the static head of the water in the various bores expressed as height above sea-level at which the water should come to rest if confined in a column. The water in the Claremont-South Perth horizon has a static head varying in different bores from 110 to 121 feet above sea-level. The static head of the Leederville horizon varies from 70 to 94 feet and that of the City horizon from 58 to 81 feet. It will be seen that the static heads in the Leederville and City horizons are much the same and will not serve to separate the two. It is suggested that this is due to equilisation of pressure caused by the two aquifers coming together because of the unconformity between them.

The temperatures and static heads of several bores show variations from normal. At the Coffee Point bore, which, according to water analysis and from a study of cross sections drawn between various bores, should belong to the Claremont-South Perth group, both the temperature and static head are abnormally low, being 91deg. F and 48 feet above sea-level respectively. An explanation is difficult, as the boring record does not show that upper waters with a low temperature and pressure were passed through, which might account for these abnormal conditions by leakage. It is suggested that the low static head of 97 feet for the Redan Street bore is probably due to this cause. It is also suggested that the abnormally high temperature of 104.5deg. F. of the water from the 10in. casing of the Loftus Street No. 1 bore is due to conduction of heat from the 8in. casing, which carries water at that temperature.

* Exceptions to this will be discussed later.

Name of Bore.	R.L. at Surface. Feet above sea level.	Total Depth. Feet.	Depth to Principal Water Bearing Horizon. Feet.	Analysis.** Carbonates. (Grains per gallon.)	Sulphates. (Grains per gallon.)	Chlorides. (Grains per gallon.)	Total Solids. (Grains per gallon.)	Temp. of Water. °F.	Static Head. Feet above sea level.
Claremont No. 1	24·41	1,506	1,189	12·39	3·22	55·79	72·94	100	110
Claremont No. 2	30	1,943	1,558	15·82	2·24	40·32	59·64	104	110
Claremont Hospital for Insane	70	2,070	1,848	15·52	2·24	40·95	60·20	104	112
Coffee Point	9	1,487	1,487	11·72	3·35	45·04	61·92	91	48
King's Park No. 2	11	2,406	...	10·08	3·08	42·07	55·86	100·4	110
Leederville Sanitary Site	70	1,680	1,375	...	...	...	...	...	...
Loftus Street No. 1—8in. casing	45	1,939	1,780	11·01	3·48	42·26	56·40	104·5	110
Loftus Street No. 2	45	2,097	1,780	14·01	4·89	73·08	90·81	105	110
Old Men's Home, Claremont	17	2,196	1,828	...	...	...	...	...	...
Redan Street	47·2	1,812	1,024	11·42	4·20	30·48	47·55	100·5	97
Royal Agricultural Society, Show Ground	54	1,500	1,320	12·25	3·22	57·26	74·13	...	110
South Perth Zoological Gardens	18	1,856	1,837	13·19	4·50	46·43	...	...	121
King's Park No. 1	11	1,345	...	13·44	4·83	58·38	76·86	88	94
Leederville Recreation Ground	59	1,113	1,023	14·48	1·96	21·48	39·23	...	70
Loftus Street No. 1—10in. casing	45	1,001	945	10·60	5·67	73·32	89·72	104·5	87
Regent Street	...	1,232	881	12·36	3·00	33·96	52·56	89	71
Subiaco Municipal	117	876	876	14·70	3·99	23·87	42·98	95	74
Causeway	10	1,200	747	4·62	4·97	55·54	68·08	...	70
Hector Street	51	762	762	6·09	0·34	38·6	50·08	81	80
King Edward Street	53·6	568	480	...	...	...	...	75	...
East Perth Tramways	30	1,034	1,010	5·63	0·86	17·97	25·72	...	81
Roberts Street	51	681	490	5·75	0·67	12·94	20·21	76	63
W.A. Cricket Association Ground	12·9	948	948	...	...	...	...	...	62
Wellington Street	35	815	600	6·45	2·20	32·97	...	...	58
West Perth Station Yard	38	820	820	7·20	3·40	34·05	48·15	...	73
Bebo-Moro or Gull's	19	408	408	10·36	2·10	20·16	34·02	...	37
Brookman's Estate, Cannington	...	1,000	313	8·64	13·83	114·11	137·91	...	20
Butcher's (Garden Hill)	...	404	199	5·29	trace.	22·17	38·50	...	21
Guildford Municipal	11	1,202	1,140	5·94	9·42	74·84	92·55	...	64
Hampton Road, Fremantle, No. 1	64·23	456	434	8·40	5·25	53·13	68·53	80	24
Hampton Road, Fremantle, No. 2	68·38	1,322	433	8·61	5·04	58·31	73·64	...	75
Harper's No. 1	14	236	160	6·65	0·17	20·79	34·03	...	...
Harper's No. 2	...	242	160	...	...	...	...	...	33
Lockeridge or Hamersley's	14	798	784	4·47	trace.	10·39	23·41	...	21
Midland Junction	13	500	420	7·20	0·36	42·33	56·28	...	...
Midland Junction Municipal	...	618	564	...	...	42·34	...	...	...
Midland Loco. Workshops No. 1	43	322	280	4·68	4·93	37·83	49·40	...	33
Midland Loco. Workshops No. 2	24	890	600	3·25	4·58	50·91	65·08	...	176 (?)
Midland Loco. Workshops No. 3	...	362	...	4·90	4·94	39·73	51·97	...	...
Midland Loco. Workshops No. 4	...	353	...	...	...	...	59·04	...	...
Midland Loco. Workshops No. 5	...	218	...	...	...	...	...	...	...
Munday's	22	340	304	...	...	...	32	...	32
Nicholson's	...	400	302	...	...	...	...	...	...
North's	...	589	160	3·54	4·27	41·58	52·03	...	...
Padbury's	...	755	347	8·89	1·61	24·08	36·12	...	46
Perth Racecourse No. 1	40	1,100	1,070	4·89	0·85	22·18	31·89	...	59
Perth Racecourse No. 2	13	1,109	1,075	...	...	...	...	...	...
Waterhall or Morrison's	35	691	691	4·48	4·69	49·63	62·44	...	46
West Guildford	...	1,410	1,395	10·63	16·24	132·76	162·19	...	28

** These figures are compiled from the reports of the Interstate Conferences on Artesian Water (1912, 1914, 1921, and 1924), and from information supplied by the Government Mineralogist and Analyst.

5.—REPORT ON INSPECTION OF THE MT. MAGNET DISTRICT.

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

Following instructions to make an examination of the Boogardie "Deep Lead," I arrived at Mt. Magnet on 13th December. Here I was met by the Secretary of the Road Board and the Secretary of the Prospectors' Association, who provided transport and arranged with various prospectors to guide me about the district.

Besides making an examination of the so-called "Deep Lead" at Boogardie, at the request of various prospectors I inspected several other localities where prospecting is or has recently been active.

The Boogardie Deep Alluvial.

The Boogardie "lead" lies under a wide flat on the west side of Jones' Creek. The lead extends from the Boogardie Recreation Reserve for a distance of about half a mile to the north.

The floor of the lead, as exposed in the shafts, is composed of kaolin, which probably represents a decomposed greenstone. That this kaolin represents the country rock is indicated by the presence in it at a number of places of jasper bars, which do not extend upwards into the wash.

Lying directly on the kaolin floor there is a variable thickness of from two to ten feet of wash, varying in character. The usual appearance of this wash is that of a gritty kaolin, carrying water-worn quartz and quartzite pebbles from the size of a small pea up to two or three inches in diameter. Interspersed irregularly throughout there are masses of ironstone, which at first sight have the appearance of being foreign masses buried in the wash, but on close inspection it is seen that the ironstone is composed of the same material as the ordinary wash, but is heavily impregnated with iron oxide.

On Latham and Vaughan's claim, near the head of the lead, there are in the wash a number of large boulders and fragments of quartzite and jasper, some of which are fairly well water-worn while others are quite angular.

The rocks composing the large boulders and fragments and the smaller pebbles are similar to rocks seen outcropping in the ridges to the north and east of the lead.

The coarse and fine material in the wash shows little if any sign of being sorted, and many of the fragments show very little sign of being water-worn. However, in the bed of a stream in an arid climate where the flow is only intermittent, marked sorting of the transported material is not to be expected, and as the source of the wash is probably at no great distance from its present position, the lack of attrition exhibited by many of the rock fragments is not surprising. In the writer's opinion the wash in this lead is a true water-borne wash, but one, the component pebbles of which, have not travelled far from their source.

The wash is overlain by a ferruginous laterite which extends right up to the surface, and varies in thickness from 20 to 40 feet.

The gold appears to be very irregularly distributed in the wash, but is apparently confined to the first three or four feet above the floor. On being questioned, various prospectors expressed different opinions as to the location of the gold.

On Latham and Vaughan's claim the gold is said to be confined to a channel or gutter about 12ft. wide, which is marked by an abundance of dense iron-stained wash or "ironstone" in white "pug" and fine grit. The gold is said to be associated with the ironstone boulders and the "pug" or wash in their vicinity, while similar wash, without associated ironstone boulders, is said to carry little if any gold. Where the ironstone is less dense and more of a loose gravelly nature, the values are said to be poor.

On Harris and Love's Claim (M. 6) the gold is said to occur within the wash close to the floor. The wash is said to be richest near the top of the rolls or banks, of which a number occur in the floor on this claim. In the gutters between the rolls the wash is said to be generally poor.

Similar conditions are said to prevail on Wright and Watson's Claim, which adjoins, on the north, that described above. I was informed by Mr. Watson that slugs, when they occur, are not found on the bottom but about six inches above. They may be in either the white gritty wash or in the ironstone patches.

On Moller's Claim, which adjoins Harris and Love's Claim on the south, the gold is said to occur in the ironstone but not in the ordinary wash or "pug" near it. On this claim the floor of the wash is very irregular, and the prospectors do not consider that the occurrence of the gold bears any relationship to the rolls. I was shown two slugs of gold which came from this claim and which were said to be typical of most of the slugs from the alluvial workings. The larger of these two weighed about 24 dwts. and was elongated and flat and had an extremely rough surface. It could not have been transported by water for any distance and still keep its rough surface.

The absence of a well defined gutter, the distribution of the gold in irregular patches, and the rough surface exhibited by most of the slugs so far recovered, suggest that this deposit is not an ordinary alluvial lead, in which the gold has been transported to its present position by running water in a stream bed.

In the writer's opinion the gold has been deposited in its present position by precipitation from solution. The ironstone masses within the wash may have had some controlling influence, because slugs of gold are often found within or close to them. This, however, is not an invariable rule, as slugs and fine gold are often found in white wash well away from the ironstone masses. The nature of the surface of these slugs appears to be controlled by the nature of the enclosing wash, those slugs occurring in the ironstone patches or in the gritty wash being rough, while those occurring in masses of white "pug" are smooth. This is what one would expect if the slugs are formed by precipitation around some centre; the surface of a slug would naturally take its form from the surrounding wash or "pug." Another fact which supports the precipitation theory is that, in the vicinity of a slug, the surrounding wash often carries much fine gold, while further away similar wash is barren or very poor.

It appears, therefore, that in this deposit a defined gutter carrying gold is not likely to be found and that the gold will continue, as in the past, to be found in irregular patches. No advice as to the location of these patches can be offered, as they appear to occur at random without any definite relation to visible changes in the appearance of the wash.

Other Deep Alluvial Patches.

Two other deep alluvial patches, which have been worked in the past, were examined. As the workings were almost inaccessible the writer had to depend a great deal on descriptions supplied by those who had worked the patches, in order to form conclusions.

One of these patches, known as Burt's Alluvial Reward, is located about half a mile to the north-northwest of the Morning Star Lease, and the other close to the Mt. Magnet-Boogardie Road, northeast from the Hesperus Dawn Lease. In both cases the gold appears to have occurred in isolated patches and to have been due to precipitation from solution in irregular patches. In neither case is there evidence of a definite "lead."

Poverty Flat.

The writer was shown where a considerable amount of work has been done in this area, with some remarkably rich returns. The gold here occurs in breaks or cross faults cutting through a series of narrow jasper bars, and the prospectors of the district are anxious to know whether further possibilities exist within the area. The structure is complicated by an extensive intrusion of porphyry, which has displaced the jasper bars in several places. Owing to the workings being at present inaccessible, the writer was unable to form any conclusion as to the future possibilities of this area. A detailed underground examination of the structural features as exposed in the workings would be necessary before any useful advice could be offered.

Other Inspections.

The remainder of the time spent in the Mt. Magnet District was taken up with giving advice to individual prospectors, who found themselves in difficulties in regard to the structural features of the areas on which they were working. The inspections were of too brief a nature to allow of any definite conclusions worthy of record being arrived at.

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DIVISION V.

School of Mines of W.A.

Kalgoorlie,
7th December, 1932.

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 1932.

ENROLMENTS.

The individual enrolments during the year numbered 298, an increase of 40 on the enrolments for 1931 and a marked increase over those for a number of years immediately preceding.

The class attendances have been satisfactory, although there has, as usual, been a falling off of students as the year progresses. It is unfortunate that this falling off should take place, although it has always been the case at this school, and, I believe, the same applies also to other similar institutions. The falling off in class attendances has, however, been slightly less than in 1931.

The enrolment in the Preparatory Classes has been somewhat less than in previous years, but this is mainly due to the fact that many of the students now attending the school have either passed the University Junior Examination or the Leaving Certificate Examination, or have reached a standard high enough to permit of them being exempted from attendance at the Preparatory Classes. In addition, the school has attracted a number of University graduates who have obtained employment on the mines in the district. These facts have increased the enrolments in the Senior or Course Classes, in which the enrolments have in most cases been much greater than for many years.

In addition to the students regularly attending classes, a number of ex-students who have obtained positions at Gwalia and Wiluna have received the assistance and direction of the lecturers in the continuance of their studies. This arrangement makes it possible for these students to keep on with their education, although they are unable to attend lectures, and gives them an opportunity of completing Diploma or Certificate Courses. In this connection it is pleasing to express my appreciation of the assistance given to these students in carrying out the necessary practical work by the managements and technical staffs of the mines on which they are employed, and also in the conduct of the examinations at those centres.

REVENUE.

The total revenue for the school year has been over four hundred and fifty pounds, a portion of which consists of fees received in connection with the conduct of experimental investigations and special assays in the Metallurgical Laboratory.

METALLURGICAL LABORATORY.

During the year the following investigations have been carried out at the request of persons interested in the materials tested:—

- Treatment of cyanide residues from Southern Cross.
- Cyanidation of battery tailings from the Gimlet South Mine at Ora Banda.
- Cyanidation of tailings from the Big Blow Mine at Coolgardie.
- Treatment of cupriferous gold ore from Rothesay.
- Cyanidation of old concentrates from the Menzies Consolidated Gold Mine.
- Amalgamation and cyanidation of ore from Hampton Plains.
- Cyanidation of Youanmi tailings.
- Cyanidation of tailings from the Ida H. Gold Mine.
- Treatment of ore from Norseman Gold Mines.
- Cyanidation of accumulated slime from the Ingliston Consols Extended Gold Mine at Meekatharra.
- Cyanidation of sands from the Secret Gold Mine at Higginsville.

In addition, assistance and advice have been given to several persons interested in the treatment of ores and tailings.

It is expected that early in 1933 the School of Mines will be called upon to investigate and work out the treatment of ore from the Cracow Goldfield in Queensland. It is a compliment that the investigation of the treatment of ores from the other States should be entrusted to the Metallurgical Laboratory of this school, which, so far as I am aware, is the only laboratory of its kind in Australia which is capable of carrying out this type of research.

During the year the number of assays and chemical determinations made in connection with the investigations conducted in the Metallurgical Laboratory has been as follows:—

Gold assays	907
Chemical determinations and analyses	990
Total	1,897

These figures include a number of check assays which have been regularly conducted during the year for Wiluna Gold Mines, Limited, and for which fees have been charged.

The Research Metallurgist, Mr. W. G. Clarke, has carried out the work of the Metallurgical Laboratory enthusiastically and skilfully, with the assistance of his cadet, Mr. A. M. Smith, who has now obtained an appointment as assayer on Norseman Gold Mines, where his experience with Mr. Clarke should be of value to himself and to his employers.

PUBLIC ASSAY DEPARTMENT.

The increased activity in prospecting for gold, which was reflected in the large increase in the number of free assays conducted for prospectors during 1931, has shown signs of increasing rather than of diminishing during the past year, if the volume of this work can be taken as a criterion. Although at the beginning of the year prospectors were notified through the Press that the number of free assays conducted weekly for any one person would be limited, and that the conditions governing the conduct of free assays would be strictly enforced, the number of free assays and mineral determinations carried out during the year has shown a marked increase over that for 1931. The number of free assays and mineral determinations conducted for prospectors during the year has been as follows:—

Gold	1,513
Other metals, etc.	17
Mineral determinations ..	140
Total ..	1,670

This is a direction in which the School has been of great assistance to prospectors, who, in many cases, are unable to afford even the small fee charged by public assayers, and it is a service which is greatly appreciated by these prospectors.

In addition to the free assays for prospectors, a number of assays have been carried out for the Gold Stealing Detection Staff of the Criminal Investigation Branch of the Police Department, and technical evidence has been given relative thereto in court cases instituted by the Police Department.

PART-TIME INSTRUCTORS.

Messrs. C. D. Slee and J. B. McNeill have continued to give good service as Part-time Instructors in Fitting and Turning and in Engine-driving respectively, while the class in Elementary Mathematics has been taken over by Mr. R. V. Lawson, who succeeded Mr. G. M. Lumb as Registrar in February.

The class in Internal Combustion Engines has been continued as a self-supporting class for the whole of the year by Mr. A. R. E. Bosustow, who has conducted this class for a number of years and is particularly fitted for the work by reason of his experience on the mines and as Electrical Engineer to the Boulder Municipal Council.

In order to increase the efficiency of the instruction in internal combustion engines, it is proposed to utilise the balance remaining after paying all expenses in connection with this class in the purchase and installation of a small Diesel engine for class demonstration and experimental purposes. At the present time sufficient funds are not yet available from this source.

GENERAL.

At the commencement of the year Mr. J. A. Agnew, Chairman of Directors of Lake View and Star, Limited, sent out from England a young student with the object of taking the mining diploma at the school, and, at the same time, of gaining the necessary practical experience while attending the school. This student, who is the fourth whom Mr. Agnew has sent out to this school from England, has done a year's good work, and gives promise of being a highly satisfactory student and of justifying Mr. Agnew's action in sending him to Western Australia for education and experience. It is gratifying to have a Mining Engineer of Mr. Agnew's standing recommending students to come from England to this school in preference to mining schools in England, and the fact that of the three students who previously came here from England two are holding highly responsible positions in Italy and Spain, shows that the instruction given in this school enables its graduates to hold their own in competition with graduates of other mining schools.

The school continues to receive practical support from several of the mining companies in Kalgoorlie, more particularly from Lake View and Star, Limited, South Kalgoorlie Consolidated, and Boulder Perseverance, Limited, the managers of which mines have found employment for a considerable number of students. At the commencement of this year over eighty students were employed on the Lake View and Star group. A number of ex-students are employed on Wiluna Gold Mines, Limited, some of whom are continuing their studies through the medium of advice and instructions sent to them by the lecturers.

As soon as finances permit it is advisable that efforts be made to appoint an assistant capable of relieving the lecturers of some of the elementary classwork. If, however, such an appointment is not possible, the appointment of a cadet to assist in setting up apparatus and in keeping the class rooms and laboratories in proper order would to some extent relieve the lecturers of duties which they at present have to perform, and which could be equally well and more cheaply performed by a cadet. This relief would enable lecturers to give more time to the preparation of lecture and laboratory work, for which practically no time is now available during school hours.

In conclusion, I desire to express my appreciation of the work of all members of the staff who have carried on under difficulties, both as regards time available for classwork and also in the matter of supplies of apparatus, etc.

Statistics of enrolments, attendances, and examination results 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 1932.

The Under Secretary for Mines.

For the information of the Hon. Minister, I submit the report of the Deputy Chief Inspector of Machinery on the administration of "The Inspection of Machinery Act, 1921," for the year ended 31st December, 1932.

Year after year the volume of work done by this branch of the Department increases, which, in view of the general financial depression, is an extremely good sign. It is quite obvious that the inspectorial staff will have to be increased slightly.

In somewhat difficult circumstances the work was kept up to date, and it is pleasing to note that the financial result showed an excess of revenue over expenditure of £989 6s. 4d.

During January, 1933, Mr. B. Prynn Jones, Deputy Chief Inspector of Machinery, retired from the Service, having reached the age limit. He was in charge during the full period under review, and great credit is due to him for the efficiency and smooth working of the branch. Mr. Jones joined the service as an Inspector on 14th July, 1902, and was placed in charge of the districts comprising the Murchison, East Murchison, Peak Hill and Yalgoo Goldfields. During August, 1909, he was transferred to the Eastern Goldfields, with headquarters at Kalgoorlie. In January, 1926, he was promoted to the position of Senior Inspector at Head Office, and on 12th November, 1928, he was appointed Deputy Chief Inspector of Machinery. I desire to express my appreciation of his very fine record of service; his work was always thorough and efficient. He proved himself a capable engineer, and won the respect of the Department and the public.

A. M. HOWE,
Chief Inspector of Machinery.

25th March, 1933.

To the Chief Inspector of Machinery.

I have the honour to submit my report upon the operations of the Inspection of Machinery Act, 1921, for the year ended 31st December, 1932.

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

1. Inspection of Boilers.
2. Explosions and interesting defects.
3. Inspection of Machinery.
4. Prosecutions under the Act.
5. Accidents to persons caused by machinery.
6. Engine-drivers' examinations and kindred matters.
7. General.

DIVISION I.

Inspection of Boilers.

For the purpose of the above Act, the definition of the term "Boiler" appears to be very comprehensive and to include every type of steam vessel working above atmospheric pressure, and all other vessels working above 30 pounds per square inch pressure. Such is not actually the case, because there are a number of vessels of small dimensions working at comparatively high pressure, some of which unfortunately have exploded in the past, which are not subject to the provisions of this Act. Also there are some boilers working in remote parts of the State which are "unproclaimed districts," and for which the cost of visiting for inspection purposes is at present prohibitive.

The total number of boilers and pressure vessels upon the Register classed as still fit for service on 31st December, 1932, was 3,722. During this year there were 55 new boiler registrations, four transferred from other departments, and one imported from Eastern States; total 60. The reductions being 12 condemned, one exported to Eastern States, one transferred to other department; total 14, leaving a net increase for the year 46.

Of the 55 new boilers registered, 44 were imported and 11 made in W.A. In this connection it would be explained that it is not commercially practicable to manufacture in this State many of the types of boilers now required to meet the needs of industry because of the enormous capital outlay that would be necessary for special machine tools and equipment in order to be able to manufacture even such a limited output.

The total number of internal and external inspections of boilers made during this year was 1,467 whilst 29 inspections have been made of boilers under steam. The corresponding figures for year 1931 were 1,458 and 44. This shows a disproportionate number of inspections under steam, but such is unavoidable with the existing limited staff of inspectors, which is fully occupied in keeping thorough inspections up to date.

The total number of Certificates for Boilers issued was 1,465, the corresponding number of year 1931 being 1,459.

The number of Repair Notices issued was 335 as compared with 304 for year 1931. The number of Boilers, particulars of which are recorded, as known in unproclaimed districts, remained the same, viz., 51, but there were many more of which this Branch has no official record.

Maintenance.

Boilers generally have been well maintained and in no small measure is this due to the activity of inspectors—assisted by our system of records and inspections.

With but few exceptions the feed water being used for boilers is of good quality. Particular attention is paid to this matter by inspectors, who have the power to prohibit the use of unsuitable feed water.

It is pleasing to quote the opinion of one of our recently appointed inspectors that he was much surprised to find that our system of records was so complete and our methods of inspection so efficient. Every endeavour will be made to maintain this standard.

As in past years, the prohibitive cost of new boilers has necessitated the re-conditioning of many old vessels to meet the demands of industry. For the same reason some extensive repairs have been resorted to in order to retain very old boilers in service which under more favourable circumstances would have been replaced by new boilers. In this connection one boiler, at least fifty years of age, is still in commission.

The application of autogenous welding has made possible some repairs which otherwise would have been prohibitive in cost.

Two Filtrator feed water treatment plants have been installed at Kalgoorlie and are working satisfactorily. The boilers served by this plant are now reported as practically free of any scale.

The time is approaching when something more than visual inspection is necessary in the case of material forming parts of a boiler which has been in regular work for any period over 40 years, of which boilers we have now a small percentage on the register, and I consider arrangements should be made with owners in such cases, as opportunity arises, for the cutting out of suitable test pieces and submission of same to standard tensile and bending tests.

DIVISION II.

Explosions and Interesting Defects.

It is with much satisfaction, and it may be considered as some criterion of the efficiency of the work of this Branch, that there was again no explosion to record of any vessel subject to inspection under the provisions of this Act.

Every year adds to the responsibility of inspectors, because many boilers are now approaching thirty years and some are over forty years of age. Although such boilers, to all appearances, are in good order, experience has shown that material of such age, subject to alternating stresses caused by repeated variation of pressure and temperature, does deteriorate. Age alone may not be a factor of deterioration, but this must be accepted as some guide to the limit of application of such stresses, which cause fatigue and ultimate failure. Test pieces of such material of known age can give the only reliable information upon which extended service may be permissible with safety.

Experimental tests to destruction of plain cylindrical vessels have shown that the possible life of such vessels subject to fluctuating internal pressure, may be stated in terms of the number of alternations of stress, being in the region of 400,000 alternations of pressure without the accompanying alternations of temperature, and equivalent to a normal working life of a boiler of about 100 years. In practice, such length of service is considerably affected by design, material, and working conditions, so that probably 50 years might be considered a very reasonable limit. This is at least an age at which a boiler should be viewed with a considerable amount of suspicion.

Some anxiety has been occasioned by the recorded failure in the Eastern States and New Zealand of certain boilers having longitudinal seams of lap construction, of which we have one or two recorded instances of failure also in this State. From a study of the cases quoted, I find that, in a high percentage of these cases, warning was given of the development of defects by visible leakage at such seams which was detected by inspector and measures promptly taken to prevent more serious consequences.

Another defect which has been reported as the cause of a serious mishap in the Eastern States is the withdrawal of tubes of water tube boiler under pressure where improperly expanded and bell-mouthed in their seatings. These matters are receiving the particular attention of inspectors in this State.

It has been necessary to condemn certain parts of some cast iron vessels in the process of manufacture in this State. Where cast iron is involved, such material, unless of good quality, is not reliable for the construction of vessels subject to high pressure and temperature.

DIVISION III.

Inspection of Machinery.

The total registrations of machinery still classed as useful at the close of this year was 9,550, being 531 in excess of the number at the close of 1931. The total number of inspections carried out were 7,235 as compared with 6,807 in 1931, showing an increase of 428 for this year; the certificates issued bearing fees being 3,085 compared with 2,944 for year 1931, an excess of 141. Certificates for steam driven plants where no fees are concerned show a slight decrease in number, being 236 as compared with 244 for 1931.

During the year 366 notices for guards, etc., have been issued, being 61 in excess of the figure for 1931.

There has been an increase of six new passenger lifts and four new goods lifts, and one old hydraulic lift has been declared out of use.

It will be seen that in all directions the volume of work is steadily increasing, and it becomes increasingly difficult to deal adequately with all the problems which arise in connection with winding engines, cranes, lifts, and other types of machinery where safe loads and methods of control, etc., have to be determined.

Steam for power purposes in small industries is being displaced by electric motors and internal com-

bustion engines, but in larger electric power supply stations, steam in conjunction with turbines has not yet been superseded owing to the advance made in steam practice in recent years, by adoption of higher pressures and larger and more economical steam generating plant; the only competitor, viz., natural water power, not being available here. Suction gas engines using native timber as fuel are still the most economical power in localities remote from railways, whilst for power plants where railway facilities exist for the transport of oil, the use of Diesel type engines has proved most economical. In the vicinity of collieries, pulverised coal is being used with good effect, and in some few instances it has been found most economical to use oil fuel in conjunction with steam generators, mostly where steam is required for heating purposes rather than for power.

Notable installations of recent date have been the Diesel-electric equipment of mining plants at Wiluna and at Kalgoorlie. At the former, two electric winders form part of the equipment, and sufficient experience should now be available to determine their economy or otherwise as compared with the steam winders at Kalgoorlie, which have been reconditioned and retained in service.

Slight revival in the timber industry has brought some of the idle existing machinery into use again, of which some, particularly the locomotives, is in need of replacement, but this revival has not been sufficient to warrant any expenditure on new plant.

The dairying industry has called for some new plant in connection with butter factories and milk condensing factories.

The building trade has been quiet with a consequent diminution of activity in allied trades of structural steel, cement, brickmaking, woodworking, and furnishing, etc. The completion this year of one or two large buildings has included the installation of some few new lifts, notably Newspaper House and the new Commonwealth Bank. In the latter a very complete and up-to-date equipment has been installed with direct current motors, which lend themselves to more flexible control, and with a selective system of push-button control, which should tend to economical working and greater convenience to the public using such lifts.

Return showing Operations in Proclaimed Districts during year ended 31st December, 1932.

(Machinery only.)

	Districts worked from Perth.	Districts worked from Kalgoorlie.	Totals.	
			1932.	1931.
Total registrations useful machinery	8,079	1,471	9,550	9,019
Total Inspections made	6,375	860	7,235	6,807
Certificates (bearing fees)	2,849	236	3,085	2,944
Certificates (steam without fees)	207	29	236	244
No. of extension certificates issued under Section 42 of Act	...	...	...	...
Notices issued (Machinery Dangerous)	345	21	366	305

Return 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, 1932.

Classification.	Districts worked from Perth.	Districts worked from Kalgoorlie.	Totals.	
			1932.	1931.
No. of groups driven by steam engines	684	362	1,046	1,045
No. of groups driven by oil engines	1,404	118	1,522	1,373
No. of groups driven by gas engines	120	89	209	215
No. of groups driven by compressed air	8	35	43	41
No. of groups driven by electric motors	5,860	867	6,727	6,342
No. of groups driven by hydraulic pressure	3	...	3	3
	8,079	1,471	9,550	9,019

Return showing Classification of Lifts on 31st December, 1932.

Type.	How Driven.	Totals.	
		1932.	1931.
Passenger ...	Electrically driven ...	131	126
	Hydraulically driven	1	...
Goods ...	Electrically driven ...	110	106
	Hydraulically driven	2	3
	Belt driven	6	6
		250	241

DIVISION IV.

Prosecutions under the Act.

It was not found necessary to institute proceedings against any firm or person during the year for any breaches of the provisions of this Act. Warnings have occasionally been necessary and have invariably been sufficient to convince persons concerned that requirements of the Act must be complied with. In such cases firmness and tact will generally bring about the desired results.

Unfortunately, it has been necessary to refer the matter of collection of fees in some cases to the Crown Law Department. Such cases have been leniently dealt with, and every consideration extended owing to the existing financial emergency.

DIVISION V.

Accidents to Persons Caused by Machinery.

Reviewing the accidents during the year, the total number of 29 only may, I think, be claimed as indicating a very satisfactory state of efficiency of the safe-guarding methods adopted by this Branch when it is considered that some 9,550 groups of machinery have been subject to inspection, representing a very considerable horse-power distributed over all kinds of industry in all parts of the State.

Unfortunately the proportion of fatalities has been high. One was caused by the bursting of a pulley upon a circular saw drive which struck a boy, who was killed. This equipment was of a temporary nature, being driven by a motor car temporarily

fixed for the purpose. The machinery was not registered and consequently not inspected, and when subsequently located, was found in such a condition that it would not have been permitted to be worked. It was considered that prosecution of the owner, after the loss of his son, would have been an additional burden which could not be imposed.

Four fatalities in all were caused by belting and pulleys. Two at outback mining plants which had not been registered nor inspected prior to the accident—one due to falling from a ladder whilst "putting on" a belt—one due to clothing being caught when "putting on" a belt at a flour mill. In the latter two cases there was a considerable amount of unintentional contributory negligence on the part of the deceased. It is not wise nor necessary to take any risks with belting. Where belting of any considerable speed or power is to be "put on" the motor or engine should be "slowed down." This is only momentary and is the only safe procedure.

One fatality was caused by falling down a lift well from ground floor to basement. An elderly man succeeded in opening an enclosure door at the ground floor and without precaution stepped forward and fell to the basement.

One fatality occurred under peculiar circumstances. A feed water heating tank containing water practically at boiling point, sunk in the ground, but with the top projecting about 18 inches above ground, covered by boarding, was selected as a temporary seat by deceased, who, in the act of sitting down, disturbed the loose cover boards which fell into the tank, and so precipitated the deceased, who fell backwards into about 2 feet 6 inches of boiling water. He was quickly assisted out by witnesses of accident, but subsequently died as result of shock and scalding.

Accidents such as above referred to seem inevitable at times, despite the efforts on all sides to safeguard human life wherever danger can be anticipated. Of the less serious accidents, circular saws account for five, buzzers 2, and shapers 1. The special attention paid to guarding of buzzers in recent years has been productive of satisfactory results, and circular saws are receiving special attention now, but it is somewhat difficult to adapt modern guards to old and sometimes crude machines, and to condemn the machine would often put the owner out of business where small firewood saw-benches are concerned, but improvements are gradually being made.

Tinware working plant has again been responsible for three accidents, and printing machinery for one, again due to old type machines, and in part due to want of precaution by operators.

DIVISION VI.

Engine-drivers' Examinations and Kindred Matters.

There has been a slight decrease in the total number of engine-drivers' certificates issued this year, being 159 compared with 182 for 1931.

During the year four examinations were held in Perth, two in Kalgoorlie, and one each in Leonora and Bunbury. Examinations advertised for Wiluna, Meekatharra, and Geraldton did not produce the requisite number of candidates.

Ten days were occupied in examinations by Travelling Board, and 13 days were occupied investigating matters connected with engine-drivers and boiler attendants, etc., whilst 23 days were occupied in Perth dealing with examination papers and applications for examination, etc.

Complaints, Inquiries, etc.

There has been no occasion during the year to inquire into any acts of negligence or other misdemeanour on the part of any engine-drivers other than in the case of some overwinds which have occurred. These are referred to in the annual report of the State Mining Engineer. Certain matters in regard to the employment of uncertificated drivers have been dealt with and satisfactorily adjusted.

The personnel of the Board has remained as before, this being Messrs. B. Pyrnn-Jones, J. Breydon, and A. M. Howe, Chief Inspector, as chairman.

DIVISION VII.

General.

"The Inspection of Machinery Act, 1921," has remained unaltered. Endeavours were made to have certain necessary amendments embodied in the Act to enable new phases of work which have developed in recent years to be adequately dealt with, but the exigencies of the times prevented any success in this direction. It is not always realised that an Act of Parliament dealing with a subject which is constantly changing must also be subject to corresponding changes, otherwise it soon ceases to be effective. Such an Act needs constant revision to keep in touch with the changes in the subject of its legislation.

Sundry work has been done for other departments, as in past years, by way of special inspections and advice in connection with steam plant and machinery.

Much time and attention has been devoted to the requirements of the Standards Association of Australia, and such work has been done mostly in the evenings. The Boiler Code and the Lift Code have now both reached a stage in which they can be tentatively applied.

Inspectorial Staff.

During the year, in order to compensate for the Long Service Leave of Senior Inspector W. Churchill, and in a measure to prepare for the contemplated retirement of the Deputy Chief Inspector, Mr. B. Prynn-Jones, on his attainment of the age of sixty-five, one new inspector, Mr. Sherman, has been appointed temporarily. As the work both on the Goldfields and in Head Office is steadily increasing, it is advisable that an increase in this staff should be contemplated, as at present many matters, such as revision of the Act, instructions for guidance of inspectors and examination papers for engine-drivers, more frequent inspection of steam plant under pressure, tabulation of winding engine data, lift data, and crane and pressure vessel computations for quick reference, in order to improve efficiency should have attention, which cannot be adequately dealt with by the existing staff. Also hy-

draulic tests are now more frequent, due to the many small pressure vessels in use which are of such shape and dimensions that computation is not always practicable. Very many boilers are becoming of such age when more frequent attention is necessary in the matter of inspection than when such vessels were comparatively new. Such extra attention naturally demands more time, which can only be made possible by an increase in the inspectorial staff.

Clerical Staff.

The clerical staff remains as before, except for change in junior member. This staff continues to give most efficient service, and to cope with the increasing volume of work satisfactorily, sundry rearrangement of the work having made this possible.

Mileage.

The mileage travelled in the various districts during the year has been 41,901, of which 39,400 has been by road, this being an increase of 3,186 miles as compared with 1931, and 2,445 by rail, being a decrease of 614 miles as compared with 1931.

This road mileage is almost equivalent to the full depreciation of one car per year. This might at first sight appear costly, but such is far from being the case when all circumstances are considered. Inspection work is of such a nature that it cannot definitely be "timed." Inspection of a boiler may occupy one hour, or it may necessitate three hours. Itinerary must be maintained, and no other means of transport is so flexible as to accommodate such circumstances. The field covered annually extends from Perth to Carnarvon, Peak Hill, Wiluna, Laverton, Norseman, Ravensthorpe, and Albany, and all the intervening localities where machinery exists. Travel by any other means than car would necessitate the services of two if not three additional inspectors. I stress this point to show the necessity for the maintenance of a good car equipment.

Revenue and Expenditure.

The financial results of operations for the year 1932, in comparison with year 1931, are as follows. The total revenue, £5,656 14s. 7d., shows an increase of £155 6s. compared with £5,501 18s. 7d. for year 1931. This is due almost entirely to additional inspections of machinery. The total expenditure has been £4,667 8s. 3d., being £687 6s. 10d. less than for previous year, this being £5,354 15s. 1d. The net result of the operations for the year is an excess of revenue over expenditure of £989 6s. 4d. As the revenue of this branch is principally a direct result of the personal energy of inspectors, such a result as shown is most creditable, and, I beg to respectfully suggest, warrants some better consideration for such officers.

In conclusion, I desire to tender my thanks to officers of other departments who have rendered assistance in matters pertaining to this Act, and to record my appreciation of the efforts of the staff during a somewhat strenuous year of work.

WALTER CHURCHILL,
Deputy Chief Inspector of Machinery.

31st March, 1933.

DIVISION VII.

Annual Report of the Chemical Branch, Mines Department, for the Year 1932.

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 1932.

General.

The demands on the Laboratory for technical advice and scientific investigation have continued to increase during the year. They have now reached a point at which, in spite of the staff being overworked, it has been found impossible to meet all the demands, and in several cases departments, for the first time, have had to be "rationed," only a fraction of the work asked for being done. A major factor in bringing about this state of affairs is the very large reduction made in our vote for chemicals and apparatus which is now only 47 per cent. of what it was four years ago. This has not only made it impossible to buy the apparatus required for certain investigations, but has taken up much of the senior officers' time in endeavouring to order to the best advantage within the financial limits imposed, and in trying to assemble substitutes for specially designed apparatus, and to repair and readjust apparatus fit only for the scrap heap. The equipment of the Laboratory will soon be seriously below par.

The total number of samples registered for the year was 5,713, being 43 less than last year. Additional samples submitted had to be refused or indefinitely postponed.

The sources of the samples and their allocations to the different sections of the laboratory are shown in the accompanying table:—

SOURCE AND ALLOCATION OF SAMPLES.

Source, Department, Branch, etc.	Foods, Drugs and Toxicological Section.	Mineralogy, Mineral Technology and Geochemistry Section.	Agriculture, Water Supply and Sewerage Section.
Premier's	2	3	15
Mines	28	2,111	4
Health	325	...	2
Agriculture and Agricultural Bank	78	17	716
Public Works	4	2	75
Lands and Surveys	...	...	4
Chief Secretary's	2	...	3
Forests	2	...	70
Police	132	...	...
Industries	5	...	1
Metropolitan Water Supply	3	...	453
Tender Board	197	...	1
Government Laboratory	41	129	97
Hospitals	21	...	3
Royal Agricultural Society	...	...	68
Public Pay	24	118	270
Public Free	16	660	11
Totals	880	3,040	1,793

The most numerous groups of samples dealt with were:—

Foods, Drugs, and Toxicology Section—

Milk, bovine	207
Toxicological	176
Milk, human	55
Soap	34
Cattle dip	27
Explosives	22

Mineralogy, Mineral Technology, and Geochemistry Section—

Gold battery tailings	2,036
Other gold assays	507
Mineral determinations	321
Mineral analyses	129
Silver assays	37
Tantalum and tin assays	33

Agriculture, Water Supply and Sewerage Section—

Water	718
Soil	503
Wheat	330
Fertilisers	77
Sewage	44
Fodder	22

The other samples dealt with were of the most varied character, covering the whole range of natural and artificial products.

DEPARTMENTAL COMMITTEES.

Meetings of the following committees were attended, 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.

FIELD INVESTIGATIONS.

In April I accompanied the Commissioner of Public Health to Wiluna to enquire into the possibility of poisoning arising from the arsenic fumes from Leggo's arsenic plant attached to the Wiluna Gold Mines.. We found far too great a quantity of arsenious oxide escaping into the air, and, on our return, steps were taken to have this reduced below danger point. In particular the installation of an electrostatic fume precipitator was recommended, and steps have now been taken to do this.

In May I visited Melville where emeralds and common beryl were reported to have been found. The result of subsequent prospecting has disclosed a considerable quantity of the latter, but all the emerald found so far has proved to be too full of flaws and inclusions to be worth cutting into gems. The field, however, has only been prospected on a very small scale. The mineral occurs in pegmatite veins and adjacent biotitic bands of the prevailing amphibolite.

In May also I accompanied the members of the Royal Commission on Group Settlement to the Peel Estate to advise them on certain points relating to the local soils and waters.

At the end of June I visited Dandaragan by the Hon. Premier's instructions to report on certain chemical problems of rocks, soils and waters in relation to pastures and stock. The results have been published in the "Journal of the Department of Agriculture."

In October Dr. L. J. Teakle and I proceeded to Dartmoor on a similar investigation. This is a newly settled area lying 75 miles to the north-east of Geraldton.

PUBLICATIONS.

The following technical papers covering work done in the laboratory, and matters incidental thereto, were published by members of the staff during the year:—

E. S. Simpson: Mineral Resources of Western Australia. New and enlarged edition of this folder. Published by the Government Printer.

Contributions to the Mineralogy of Western Australia, Series VII., Jour. Roy. Soc. of W.A., Vol. XVIII.

The occurrence of Andalusite, Kyanite, Sillimanite and Staurolite in the Chittering Valley. Jour. Roy. Soc. of W.A., Vol. XVIII.

The Mineralogy of the Dandaragan District, and its bearing on pastures and stock. Jour. Agr. of W.A., Vol. IX.

The Minor Elements in Living Organisms. Chem. Eng. and Mining Rev., 6th June, 1932.

E. S. Simpson and D. G. Murray: A new Sidaerolite from Bencubbin. Mineral. Mag., Vol. XXIII.

H. Bowley: On Helvite from Mt. Francisco. Jour. Roy. Soc. of W.A., Vol. XVII.

B. L. Southern: Copper Bunticides. Jour. Roy. Soc. of W.A., Vol. XVIII.

F. W. Steel: The Commercial Utilisation of Grass Tree. Chem. Eng. and Mining Rev., 5th July, 1932.

H. E. Hill and F. E. Chapman: A note on a spurious Vinegar. Chem. Eng. and Mining Rev., 5th July, 1932.

FOODS.

It was found necessary during the year to provide the Health Inspectors in their food factory investigations with additional help in the shape of an associate having a knowledge of chemical engineering. Mr. F. E. Chapman, A.A.C.I., of this Branch was therefore gazetted as an honorary inspector under the Health Act.

An undue proportion (25 per cent.) of the food samples still continues to be under standard, and many submitted by the Tender Board prove to be of very poor quality. For example, of eleven samples of butter, ten were below standard; of the same number of sausages four were over preservatised; of seven samples of bacon, six did not comply with the regulations. Tomato sauce was found in several cases to be unduly watery, and I was seriously informed in one town that a tomato sauce factory had had to be closed down because although tomatoes were obtainable in abundance there was not a sufficient local supply of melons and pumpkins.

Considerable time was spent in trying to check the flooding of the market with artificial vinegar, made from synthetic acetic acid, which was being sold as "genuine malt vinegar." After several factory inspections and numerous detailed analyses, successful prosecutions were launched by the Health Department, and it is hoped that this fraud on the public has been checked.

A serious condition of affairs was disclosed by the examination of a number of green vegetables for arsenic. It was found to be a common practice to spray cabbages and other green vegetables with arsenate of lead up to the day of sending to market, and to sell them without previous washing or removal of the outermost leaves. The result was that seriously injurious quantities of arsenic and lead were found on some specimens of such vegetables exposed for sale.

Deficiencies were frequently noted in the weights of various packages of foodstuffs.

MILK.

It is obvious that the time has arrived for a reconsideration of the milk standard, which at present requires only 3.2 per cent. of fat to be present. Dairying has been revolutionised in the past 25 years by the introduction, with Government aid, of sires from dams of high milking quality, by the routine culling out of unthrifty cows from herds, and the vast improvement in pastures brought about by top dressing, introduction of new grasses, clovers, etc., and regular growth of summer fodders. As long ago as 1911 the State average fat content of milk was 4.1 per cent., and the latest published district herd testing figures show fat from different herds ranging from 4.2 to 5.8 per cent., with an average of 5.0 per cent.

The present low fat standard would admit of extensive adulteration of milk were it not partly checked by the standard for solids not fat, and still more effectively by the freezing point method. The latter method has been applied regularly during the year to doubtful milks and a successful prosecution based on it was launched in December.

DRUGS.

The most interesting drug case investigated was submitted to us as the result of the acute symptoms of poisoning evinced by two patients in the country after every dose taken of a medicine prescribed by the local physician. It was found that one constituent of the medicine was supposed to be calcium bromide, a harmless compound, but that the local pharmacist's bottle labelled calcium bromide by the wholesale supplier contained not that substance but cadmium bromide, a highly poisonous compound used in photography. A second bottle similarly wrongly labelled was discovered in another country town.

We still continue to have frequent requests for an analysis of the last remnants, often only a thimbleful, of a proprietary medicine or cosmetic originating in the United States, France, or even China, with the idea that it could be compounded locally. Apart from the impossibility of making even an approximate analysis on such small quantites, the cost to the Government or the individual would be prohibitive, and the results of no public importance. The requests are therefore invariably refused.

TOXICOLOGY.

A heavy year, in fact a record, has been experienced in this branch of the work, which is fully dealt with in Mr. Stacy's report hereunder.

GOVERNMENT STORES.

The work done for the Tender Board in examining tenderers' samples and contractors' supplies is steadily increasing. It is satisfactory to learn from the Secretary that this work has resulted in a very considerable saving in cost of supplies, as well as a marked improvement in quality.

INSECTICIDES AND FUNGICIDES.

For the Tender Board a number of fly sprays were examined, with a view to determining their relative efficiency and economy. They all appeared to be of similar composition, being mixtures of light petroleum and pyrethrum, with or without dichlorbenzene. After consultation with the Government Entomologist it was decided that a practical test would be most satisfactory, and with his help the details of such a test were evolved and utilised successfully.

Under the Plant Diseases Act all applications for registration of an insecticide or fungicide have to be accompanied by a certificate of analysis from the Government Analyst or other competent analyst, as a guarantee that the material agrees with its declared composition. Deficiencies have frequently been noted, and are due apparently to the fact that the manufacturer often makes no allowance for a commercial compound not being of the same composition as the chemically pure salt, or for the diluting effect of moisture, or the evaporation of volatile substances during or after mixing. The guarantee should of course be based on an actual analysis of the mixture as marketed.

Mr. B. L. Southern has continued his valuable researches on bunticides, and has now published the more important results obtained in a paper read before the Royal Society of Western Australia.

ARSENIC IN TOBACCO.

It is apparently not uncommon for tobacco plants to be sprayed with arsenate of lead, and one parcel of cured leaves submitted to us carried 0.033 per cent. of lead and 0.029 per cent. of arsenic oxide. In view of this, some experiments were made by Mr. H. E. Hill to determine what the effects of smoking arsenic-tainted tobacco would be. Cigarettes of two brands on the local market were found to carry respectively 0.015 and 0.005 milligrams of oxide of arsenic per cigarette. After artificial smoking, practically the whole of this was recovered from the ash and butt, only 0.001 to 0.002 milligrams passing into the smoke. There does not appear, therefore, to be any grave risk of arsenic poisoning as the result of smoking slightly arsenical tobacco.

CORROSION OF METALS.

A number of cases of corrosion of steam pipes, etc., in Government institutions and private factories have been dealt with. In practically every case it was possible to trace the causes of these and suggest comparatively simple remedies.

METROPOLITAN WATER SUPPLY.

The Advisory Committee continues to give this their close attention. In view of the steadily increasing demand for water, two new bores alongside one another in King's Park, Perth, have been sunk and the water brought into use during the summer of 1932-3. The composition of this water, part of which is derived from a depth of 2,275 feet, is given below in Mr. Hoare's report. It is rather highly saline, but the temperature is not very high, and as it supplies only a small fraction of the whole requirement, it does not in any way deteriorate the flavour or general utility of the whole supply. Ultimately it is hoped that the coastal plain bores will all be put out of commission by the provision of a much greater supply of pure stream water from the hills. Consideration is being given to the effect on the quality of the water of the gradual substitution of cement-lined for tar-lined pipes.

FERTILISERS.

The fertilisers sold on a large scale on the local market continue to maintain their good reputation, every single sample analysed being above the guarantee. It is known, however, that small parcels of home-made fertilisers hawked round the suburbs are often of inferior quality, and frequently contain such incompatible mixtures as ground limestone or slaked lime and sulphate of ammonia.

SOILS.

Soil analysis has increased enormously during recent years. This year no less than 503 soils were actually analysed, and a number of others refused for lack of staff and apparatus to handle them. Most of the samples originate in the soils surveys of Dr. L. J. Teakle of the Agricultural Department, but an increasing number is being submitted by the Forests Department. The total soluble salts, sodium chloride and hydrogen ion concentration are invariably required, but more detailed investigations are made of typical profiles. In these cases mechanical analyses are made as well as determinations of total and available plant nutrients, exchangeable bases and individual soluble salts. Occasionally minor constituents of nutritional import-

ance, such as copper, manganese and iodine, are looked for.

Amongst other unusual soils and subsoils examined was a sample of "coffee rock," a brown, lightly cemented layer at a depth of 4 feet in the sandy soil of the Lake Gnangara pine plantation. From the researches of Mr. B. L. Southern this appears to be identical with the "alios" of the pine plantations in the sands of the Landes region of France. The rock is distinctly acid in reaction (pH 5.08) and the binding material is essentially "humic acid" carried down from the surface by alkaline waters to a depth at which an acid layer causes reprecipitation. The rock contained 88.3 per cent. of silica, with 6.1 per cent. of organic matter and only a faint trace of manganese, and 0.7 per cent. of iron oxide. The "irony" colour of the rock is due to the organic matter, not to the metallic constituents.

STOCK DISEASES.

Intimately associated with the soil work is the study of the diseases affecting dairy cattle in the Hay district and sheep in the Swan district. In addition to the elaborate soil analyses made in this connection, investigations have been made of pastures, and of likely sources of iron for combating anaemia. Suitable limonites for the latter purpose appear to be available in a number of places. These only need to be ground to an impalpable powder and made up into licks with salt. The iron ore will usually supply the subsidiary manganese required by anaemic stock, but traces of copper may have to be added in the form of one of the common copper dusting powders. Further details will be found in Mr. Hoare's report.

WHEATS.

No less than 330 samples of wheat have been examined, including representative f.a.q. samples from each of the four principal wheat-producing States. During the year there arose a public controversy regarding the alleged inferior quality of the Gluclub variety of wheat, which because of its high yield is being more extensively grown in this State each year. Figures now accumulating in the laboratory regarding this and other varieties are emphasising the previously suspected fact that grain quality depends principally not upon the variety of wheat, but upon the climate and soil in which it is grown. It is hoped in the near future to place the data obtained on permanent record.

GOLD ASSAYS.

Over 2,500 gold assays were made during the year, four-fifths of them being for the State batteries, which have been working at high pressure. The assays actually made for the Batteries Branch constituted a record in spite of the fact that towards the end of the year the branch had to be rationed. Prospectors' assays were not so numerous, but these men are catered for also by the Kalgoorlie School of Mines.

EARTHY MINERALS.

This State continues to provide unique occurrences of the mineral alunite (sulphate of potassium and aluminium). In addition to further occurrences in the form of silt in the beds of salinas in the Wheat Belt, the recent investigations of Dr. L. J. Teakle into the subsoils of the same area have revealed several places in which an alkaline top soil and upper subsoil pass downwards into an acid subsoil at depth. In some cases the latter has been found to contain white nodules, originally looked upon as "lime," but now proved in the laboratory to be alunite. This matter is referred to in detail in Mr. Bowley's report hereunder. So far our larger deposits of the mineral have not been worked on a commercial scale.

For the first time the glauconite deposits of the Swan district have been worked, and the mineral exported to the Eastern States and England for use in the manufacture of water-softening agents. Whilst in the Dandaragan district I observed extensive deposits of this mineral, which should be worth investigating. It was also found to exist in the Murchison gorge near Gantheaume Bay.

The production of felspar for use in local and Eastern States potteries shows considerable activity.

Masses of sillimanite suitable for use in the manufacture of electrical porcelain have been discovered in the Chittering Valley.

PHOSPHATIC MINERALS.

Under the Hon. Premier's instructions special attention was paid to the phosphatic minerals (of Cretaceous age) discovered many years ago in the area lying between Gingin and the Hill River. Full details have been recorded in two papers, one listed above, viz., "The mineralogy of the Dandaragan District and its bearing on pastures and stock" (Jour. Agr. of W.A.), the other "Minyulite, a new phosphatic mineral from Dandaragan," now in the press (Jour. Roy. Soc. of W.A.) The common phosphate mineral in this area is apatite (fluophosphate of lime) with dufrenite (phosphate of iron), quite abundant in places, and vivianite (phosphate of iron), and minyulite (phosphate of potash and alumina), so far as is known, confined to one outcrop. Whilst small picked samples of phosphate yield up to 39 per cent. of P_2O_5, the average content of various outcrops is only 12 to 18 per cent. P_2O_5.

In the gorge of the Murchison River, for a distance of about twelve miles inland from Gantheaume Bay, similar accumulations of coprolite, *i.e.*, concretionary apatite, have been found. They assay 28 to 29 per cent. of P_2O_5. No attempt has yet been made to define their extent.

TANTALITE.

Western Australia continues to be the chief source of the world's requirements of tantalum. Most of the ore comes from Wodgina and the surrounding district. It consists of manganotantalite associated with minor amounts of manganocolumbite and microlite. Associated with the tantalum minerals is a variable amount of cassiterite, an undesirable impurity which can be removed by electromagnetic separation. Assays of all export parcels and of many prospectors' samples have been made in this Laboratory.

BASE METALS.

Owing to the low prices still prevailing for these, prospectors are paying practically no attention to them. The number of samples of ores of lead, copper, tin, etc., which has been received, is therefore unusually small.

MINERAL DETERMINATIONS.

Amongst the 321 minerals submitted for determination and report as to their value were several of industrial importance or scientific interest from new localities. Some are mentioned above, and others are listed below.

Minyulite, Dandaragan.—A basic phosphate of potassium and aluminium, new to science, and occurring in a bed of phosphate ironstone of Upper Cretaceous age.

Euxenite, Mt. Dale.—A titanoniobate of yttrium, not previously found in the State. The mineral recorded under this name from the North West many years ago, proved on intimate investigation to be tanteuxenite, the corresponding tantalum compound.

Grossularite, Melville.—This lime-alumina garnet was found associated with gold in quartz veinlets and the enclosing hornblende schist.

Topaz, Melville.—A fluosilicate of aluminium occurring in large masses in two separate pegmatite veins.

Tapiolite, Jimperding.—A few crystals of this rare tantalate of iron have been found in gold washings associated with columbite (niobate of iron).

Corundum, Lower Chittering.—Large crystals partly altered to mica were found for the first time in mica schist in this district.

EDWARD S. SIMPSON, D.Sc., B.E., F.A.C.I.,
Government Mineralogist and Analyst.

SECTION 1—TOXICOLOGY, FOOD AND DRUGS.

(By C. E. Stacy, A.A.C.I.)

During the year 880 samples have been examined in this section. Apparently this is only a small advance over the 1931 figures, but it should be remembered that last year's figures included 204 revenue stamps, whereas none was done this year. This really means an increase of 209 ordinary samples, which must be regarded as very satisfactory. The advance is mainly due to the use of this section by the Tender Board and greater activity by the Health Department. By the former 197 samples were submitted as against 139, and by the latter 325 as against 206. It is gratifying to note the greater use which the various departments are making of this section.

I think it is well to point out that most analyses carried out by this section take quite a long time to complete, which accounts for the comparatively smaller number of samples being dealt with by it. The examination of a medicine, or of a toxicological or food sample, is in nearly all cases a long and tedious process; moreover, attendance at the police courts causes a further tax on the time of all officers of this section.

Toxicology.—A new record has been created in this direction. No fewer than 176 exhibits have been received as against a previous record in 1931 of 136. Strychnine, lysol and arsenic have been the most commonly used poisons, cyanide coming next in frequency. There was one case of poisoning by carbon monoxide, and one by eucalyptus oil.

A curious case of what was obviously bacterial food poisoning was recorded when a family of eight were attacked after eating water-melon. This resulted in the death of a child of seven years, whilst the others were severely ill. The public had been previously warned by the Commissioner of Public Health against eating fruit which had been cut and left exposed to the risk of contamination by pathogenic bacteria, and it is hoped that this warning will be more carefully observed in future. This kind of poisoning was formerly called ptomaine poisoning, a term still used by most of the public and some medical practitioners. It is now known that some true ptomaines are innocuous, and some are found in the intestinal tract. But ptomaines only develop in protein matter which has reached a state of putridity, which prevents their consumption and are, therefore, unlikely to be dangerous unless directly injected into the blood system. Food poisoning is caused by specific pathogenic bacteria belonging as a rule in this country to the Gaertner or allied groups.

It is necessary again to warn medical practitioners against the practice of adding preservatives, particularly formalin, to toxicological exhibits forwarded to the laboratory for analysis. A printed "Advice letter" is available at practically all police stations, deprecating such a practice. If samples come from a distance they should be packed in ice if possible, and spirits of wine should be used for preservation only as a last resource. Formalin renders the detection of cyanide impossible, and it is unlikely that any poison, except perhaps arsenic and other metallic poisons and strychnine, will remain unaffected by it as it is a very powerful reagent.

Foods and Drugs.—325 samples were examined for the Health Department, an increase of 119 over 1931. The more important of these will be commented upon.

Milk.—Of 207 samples analysed 51 failed to comply with the Food and Drug Regulations, and a number of successful prosecutions were launched. The Laboratory possesses a Hortvet cryoscope which detects adulteration by water even when the chemical analysis passes the regulations. This instrument determines the freezing point of milk, which the Food and Drug Regulations decree "shall not lie between zero centigrade and 0.55 degrees centigrade below zero."

Human Milks.—Fifty-five samples of human milk have been analysed, in nearly all cases for hospitals and infant welfare clinics, which are not charged for these examinations.

Butter.—Three samples of butter were examined for the Health Department, two of which did not comply with the regulation. In addition eight were examined for the Superintendent of Dairying, six of which did not comply with it.

Drugs and Medicines.—Ten samples were examined during the year, most of them being suspected of use for unlawful purposes. This work is of a particularly complicated and difficult nature, but we were able to furnish valuable information to the Commissioner of Public Health. In one case cadmium bromide was supplied for calcium bromide—a very serious mistake.

Occasionally we are asked to analyse medicines for private individuals who allege ill effects, or for the disclosure of the formulas. Unless they are sup-

ported by a request from the Police Department or some other accredited authority, they are discouraged on account of cost and because such analyses are not of public interest or value.

Sausages.—Eleven samples were examined, four of which did not comply with the regulations.

Vinegar.—There were eighteen samples of material classified under the head of Vinegar. Seven of these were sent in by the Health Department, of which four were found to be not genuine, two failed to comply with the labelling regulations, and in one case the analysis was not proceeded with. Six samples sent in by the Tender Board were found to be genuine. Five other materials used in connection with the manufacture of imitation vinegar were examined.

Bacon.—Seven samples were analysed, three from the Health Department, of which two did not comply with the regulations. Of the others three were from a private source, and one from the Tender Board, which did not comply.

Self-raising Flour.—Twelve samples were examined during the year. Four came from the Public Health Department, two of which did not comply with the regulations. Seven came from the Tender Board, and all complied, as did one from a private source.

Baking powder.—Six samples were received from the Tender Board, and all complied with the regulations.

Tender Board samples.—As above stated 197 samples were received from the Tender Board. In addition to the materials already referred to, they comprised fly sprays, soap and soap mixtures (34 samples), jelly crystals, cornflour, starch, coffee and chicory, essences, cream of tartar, pickles, chutneys, boot polishes, caustic soda, table salt, metal polishes, floor polishes, cocoa, and oils. The results were used as a guide in accepting tenders for supplies for Government institutions. This work is likely to increase in 1933, and will take a lot of time and consume considerable quantities of chemicals, besides entailing much wear and tear on apparatus.

Fly sprays.—Twelve fly sprays were examined, ten for the Tender Board and two for departmental purposes. The method employed, after consultation with the Government Entomologist, was as follows:—A number of blowflies were liberated in a chamber 15¾ in. x 11¼in. x 24in., and one cubic centimetre of the various sprays was injected into it. The number of dead flies was counted after 15 minutes. All the sprays were more or less effective, the average of dead flies being 80 per cent. Three samples were 100 per cent. effective, and it is pleasing to note that one of these was made locally.

Explosives and cattle dips.—Twenty-two samples of explosives were examined for the Mines Department. Twenty-seven cattle dips were analysed for the Agricultural Department, and the uniformity displayed by them was remarkable; the strength required is 0.20 per cent. As_2O_3, and none diverged by more than .01 per cent. from this standard.

Investigation of natural products.—Nine botanical samples were examined by Mr. Hill. The wood of *Casuarina lepidophloia*, a species common on the Eastern Goldfields, was investigated for the presence of essential oil and report on its commercial value. The results were negative as the sample was not fresh when submitted. Steam distillations were made of the leaves and branchlets of *Diosma ericoides* (common Diosma), *Baeckea camphorosmae* (Camphor bush), and *Hypocalymma angustifolia* (narrow leaved Myrtle) to determine the amount and nature of the essential oils present. Small yields of oil were isolated and examined.

Three samples of locally distilled oils of *Melaleuca* (Tea tree) species, and two of eucalyptus oils were examined with regard to their composition and possible commercial value. These were found to have marked bactericidal values, and one of the eucalyptus oils was shown to be suitable for medicinal use, subject to proper rectification.

Organisation.—As far as possible it has been my endeavour to so distribute the work as to give equal opportunities for each officer to show his versatility, but where an officer has had special experience in one particular line, time is often saved by allotting such samples to him. The large quantity and varied character of Tender Board samples this year have largely assisted me in this plan.

C. E. STACY.

SECTION II.—MINERALOGY, MINERAL TECHNOLOGY, AND GEOCHEMISTRY.

(By H. Bowley, F.A.C.I.)

Three thousand and forty samples were received during the year from sources shown in the table on page 55. The number received showed an increase of 73 over that for the previous year.

Arrangements will have to be made in the near future for the replacement of some of the more costly apparatus used in this section. The Keller assay balance used for fine weighings has been in constant use for sixteen years, and reasonable accuracy can only be obtained with it by constantly checking the zero and making repeated weighings. It is necessary to obtain a new balance with a sensitivity of 1/200 milligram in order to obtain results to the degree of accuracy which the enhanced value of gold demands.

Gold Assays.—2,543 samples were received for gold assay. Of these 2,036 represented tailings from the State Batteries Branch, including 118 submitted for umpire gold assay. The tailings samples assayed for the Batteries Branch exceeded those received for the previous year, although, owing to the increased cost of assay stores and the necessity of economy in expenditure in all departments, only 30 per cent. of the samples received from that source towards the end of the year were assayed. Prospectors' gold ores showed a decrease of 413 on the previous year's figures, this being due to some extent to the fact that assays are made free for prospectors by the School of Mines at Kalgoorlie, and in other cases by the managers of State batteries for a purely nominal fee.

Arrangements were made during the year with the Mines Department to supervise the boring at the Mararoa Leases at Reedys and for the cores to be assayed by this branch, the cost being defrayed by the company.

Tantalum ores.—40 samples of tantalum-bearing ores were received, the majority of them coming from the already known producing localities in the Pilbara Goldfield. Assays of parcels representing 15 tons of

saleable ore were made for tantalum and niobium. A sample received from the Prince Regent River in the Kimberley Division proved to be a mixture of tapiolite (Sp. Gr. 7.43) and tantalite (Sp. Gr. 6.64). Another consisted of manganocolumbite (Sp. Gr. 5.88), whilst a third sample with a specific gravity of 7.07 proved to be tantalite. A number of black pebbles from the outcrop of a topaz-bearing pegmatite south of "The Basin" at Melville were found to be manganotantalite, containing 65 per cent. of tantalic oxide. Manganocolumbite was found to be associated with ilmenite and tourmaline in a sample received from three miles south of Coolgardie. Manganocolumbite containing 28 per cent. of tantalic oxide was submitted from Eastern Creek, in the Pilbara Division. A black mineral passing into grey and pink, from Jimperding, with a specific gravity of 7.2 contained approximately 80 per cent. of the oxides of tantalum and niobium. Manganocolumbite with a specific gravity of 5.56, containing approximately 16 per cent. of tantalic oxide, was received also from the vicinity of Mt. Dale, about thirty miles southeast of Perth.

Coal.—Analyses were made of four samples of coal from the Stockton Colliery at Collie. The samples were collected and bottled at the face by the Inspector of Mines, and represented the full thickness of the seam being worked on 20th January, 1932.

No.	228	229	230	231
Bord	No. 12 No. 3 Left.	No. 26 No. 4 Left.	No. 6 No. 4 Right.	No. 14 No. 2 Right.
Height	7ft.	7ft. 6in.	7ft. 6in.	8ft.
Vertical Depth	120ft.	171ft.	198ft.	84ft.
Proximate Analysis:	%	%	%	%
Moisture	25·16	27·03	27·49	25·97
Volatile hydrocarbons	25·68	24·82	24·19	25·30
Fixed carbon	43·96	42·20	42·46	42·68
Ash	5·20	5·95	5·86	6·05
	100·00	100·00	100·00	100·00
Water lost on air drying for 24 hours (In lump form).	5·17	6·39	5·84	5·22
Additional water lost at 105° (In coarse powder).	19·99	20·64	21·65	20·75
Calorific Value. (By Bomb Calorimeter).				
B.T.U.	8899	8544	8460	8610
On Ash and moisture free coal—				
B.T.U.	12778	12748	12693	12665

A sample of air-dry coal from P.A. 44, two miles northeast of Collie, gave the following figures:—

Proximate Analysis.—Moisture, 14.46 per cent.; volatile hydrocarbons, 32.67 per cent.; fixed carbon, 48.34 per cent.; ash, 4.53 per cent.; total 100.00. *Calorific value*: B.T.U. 10998. On ash and moisture free coal, B.T.U. 13578.

A sample from the disturbed coal seam in the new tunnel from No. 2 Bord, Main Dip section of the Co-operative Colliery, contained narrow veins up to 0.1 inch in width of siderite (carbonate of iron) cutting across the bedding. A careful chemical examination of the unfractured coal between the carbonate veins gave a negative result for carbon dioxide. It was apparent, therefore, that in this case the siderite does not penetrate into the unfractured coal.

Alunite.—The occurrence of alunite as white porous nodules in the acid zone of a number of subsoils in various localities in the wheat belt was noted during the year. Dr. Teakle detected white nodules in a stiff red clay with some grit at a depth of 108in.-127in. in a bore hole put down on Avon Location 14005 at Goomarin. The subsoil had an acid reaction of pH 4.67 and contained 8.8 per cent. of alunite. Two samples of subsoils from Location 14219, Talgomine, at depths of 44in. to 50in., and 50in. to 58in., described by Dr. Teakle as "Yellow brown gravelly sand, with pockets of rock and red laterite patches" in the former case, and "decomposing soft rock" in the latter, with a reaction of pH 4.13 and 4.10 respectively, contained only traces of alunite. Soft white nodules, collected by Dr. Teakle at a depth of 36in.-42in. below the surface in a brown clayey soil on the north side of the lake on Location 14578 at Wallambin, proved to be alunite associated with some kaolin and quartz. A partial analysis gave the following percentages soluble in caustic soda: K_2O, 6.38 per cent.; Na_2O, 0.43 per cent.; SO_3, 24.25 per cent. Al_2O_3, 27.22 per cent., equal to 61.6 per cent. of alunite. Samples from an auger hole put down at the edge of the lake on Location 14292, Wallambin, showed acid reactions of pH 6.5 at 77in.-103in. and pH 4.03 at 103in.-120in. The samples contained 18 and 13 per cent. of alunite respectively, in the form of small white nodules. Above 77in. the reaction was alkaline.

A series of auger borings from part of Lake Wallambin, Avon Location 15680, from the surface to 66 inches in depth contained alunite associated with gypsum and kaolin. The following figures were obtained for alunite:—0in.-15in., 1.9 per cent.; 15in.-16in., 1.1 per cent.; 16in.-26in., 8.6 per cent.; 26in.-39in., 33.3 per cent.; 39in.-54in., 2.2 per cent.; and 54in.-66in., 0.2 per cent. A number of subsoils, obtained by boring on Avon Location 22635, Welbungin, ranging from faintly alkaline at 80in.-90in. to acid in reaction below 90in., contained appreciable amounts of alunite as hereunder:—

Depth	80-90in.	90-102in.	102-114in.	114-138in.
Reaction pH	7·59	5·75	4·50	4·05
Alunite %	3·93	5·17	3·93	1·51

Beryl.—A partial analysis made of a bulk sample from a pegmatite vein north of "The Basin" at Melville showed that it consisted almost wholly of beryl. The figures obtained were:—BeO, 13.60 per cent.; Al_2O_3, 65.46 per cent.

A number of small beryl crystals ranging from bright green through bluish green to sky blue were received from the same locality, but were not sufficiently transparent or free from flaws to be of gem quality. Others from half-mile south of the basin were emerald green in colour and also badly flawed. A white beryl with a specific gravity of 2.73 from Harrison's Reward M.L. at Melville gave strong spectrometric reactions for caesium and lithium. Green and blue beryls were received from the vicinity of Mt. Dale.

Beryl was reported to occur in a pegmatite 1½ miles south of Yabberup Siding, and subsequently a number of typical crystals were received from there.

Helvite.—Helvite associated with beryl and microcline occurs in a pegmatite between Harrison's Reward and The Basin at Melville. A small specimen slightly contaminated with beryl had a specific gravity of 3.15.

Senarmontite.—Senarmontite (antimony oxide) associated with stibnite, chalcedony and common opal was recorded for the first time in this State. The sample was forwarded from Whim Creek, but the exact locality of the occurrence was not disclosed.

Ceramics.—Thirteen clays were examined from various localities to determine their suitability for use in the ceramic industry.

A soft white clay from the Murchison River, between Galena and Geraldine, contained 0.95 per cent. of common salt, after the removal of which it burnt to a good white at all temperatures up to 1,350deg. C., yielding a tough porous body. The Ashley figure obtained was 50, which is that for semi-ball clay. This is a useful whiteware clay.

Terra cotta clays suitable for making drain pipes, roofing tiles and stoneware, were received from Wannamal and North Drakesbrook.

Euxenite.—Specimens of euxenite (titano-niobate and tantalate of yttrium, etc.) were received from near Mt. Dale. The specimens had a brown to cream coating of alteration products, the freshly fractured surface being brownish black and lustrous.

Diamond.—A diamond of excellent colour and lustre in the form of an octahedron, weighing 0.93 carat, obtained by a prospector whilst dryblowing for gold in the Nullagine conglomerate, was submitted for report.

Chromite.—Chromite and magnetite in almost equal proportions as an intimate intergrowth associated with a colourless silicate from six miles south of Yalgoo contained 23.3 per cent. of Cr_2O_3. The whole of the metallic portion was attracted by a magnet yielding magnettings 94.2 per cent. These, on treatment with strong hydrochloric acid gave insoluble, 49.1 per cent.; soluble, 50.5 per cent., the former containing 46.1 per cent. and the latter 4.9 per cent. Cr_2O_3, representing 90.4 per cent. and 9.6 per cent. respectively of the chromium present in the mixture.

Chromite associated with magnetite was also recorded from near Eginbah.

Molybdenite.—Molybdenite was recorded from South Bindoon. A sample, consisting of dabs of molybdenite in a mixture of granite, quartz magnetite, chlorite and limonite with a little arsenopyrite and ferrimolybdite, after cobbing and rejecting the rock which showed no molybdenite, yielded only 2.80 per cent of molybdenite. The find does not therefore appear to be of economic importance.

Bismuth Ores.—Bismuth concentrates from "The Basin," Melville, consisting of bismutosphaerite, bismutite, scheelite, quartz and limonite, assayed metallic bismuth, 32.9 per cent.; tungstic oxide, 7.85 per cent. Another sample from half-mile south east of Harrison's Reward M.L., Melville, consisted of quartz and bismutite, with no scheelite. It contained 38 per cent. of bismuth.

Sillimanite.—Sillimanite has been reported as occurring in quantity in the Chittering Valley, pieces of detrital sillimanite 100 lbs. in weight having been obtained, most of them showing a small amount of associated biotite and quartz. A mixed sample of chips from a number of pieces had the following composition:—SiO_2, 41.60 per cent.; Al_2O_3, 54.22 per cent.; Fe_2O_3, 1.74 per cent.; TiO_2, 0.16 per cent.; CaO, nil; MgO, 0.67 per cent.; ignition loss, 0.64 per cent.

Vanadinite.—Vanadinite was present in a heavy concentrate obtained from ironstone from Black Hill, Duck Creek, Boolaloo Station, in the Ashburton District.

Concentrates from Nullagine Conglomerate.—A sample of the concentrates obtained from several tons of Nullagine conglomerate proved to consist of a very complex mixture of minerals, of which the following were identified:—Barite, quartz, felspar, kaolin, zircon, limonite, xenotime, monazite, rutile, cassiterite, magnetite, ilmenite, chromite, tantalite, pyrite, and gold.

Mineral Analyses.—Complete mineral analyses have been made of the following:—

(a) *Minerals.*—Almandine, Yabberup; aragonite, Turee Station; barite, Cardup; eastonite, Dangin, Gibraltar, Greenbushes, Melville; blende, Northampton; dolomite, Dartmoor; grossularite, Melville; hydrobiotite, Yinnietharra; manganotantalite and microlite, Wodgina; muscovite, Lower Chittering; oligoclase, Westonia; sillimanite, Chittering Valley; spessartite, Melville; staurolite, Chittering Valley; topaz, Melville.

(b) *Clay.*—Goomalling.

(c) *Rocks.*—Granite, Denmark; laterite, Nornalup; porphyrite, Mt. Hilda, Warburton Range; porphyry, Hill 32, Warburton Range; staurolite schist, Goyamin Pool.

Whilst in Sydney attending a special council meeting of the Australian Chemical Institute I was appointed to officially represent the State at the meeting of the Australasian and New Zealand Association for the Advancement of Science held there in September. This brought me in intimate contact with the leading scientists of the Commonwealth and, at the same time, enabled me to gain some knowledge of the scientific and industrial activities of the Eastern States which will, no doubt, prove of benefit to this Department.

H. BOWLEY, F.A.C.I.

SECTION III.—AGRICULTURE, WATER SUPPLY AND SEWERAGE.

By A. J. Hoare, A.A.C.I.

Although the number of samples (1,793) entered for 1932 is less than for the previous year, a large number of soil samples (122) was not registered in the office, but was held over to be entered as opportunity occurs to tackle the work. The sources of the samples will be found on page 55.

Soils.—Of the 503 soils received during the year, 179 were type samples, collected by the Plant Nutrition Officer, during soil surveys of the Lake Brown and Salmon Gums areas. These were all tested for total soluble salts, sodium chloride, and reaction (pH). Only typical profile samples were picked out for more detailed investigation, such as mechanical and chemical analyses, composition of the water soluble salts, and exchangeable bases. The fine sand fractions from the mechanical analyses have in some cases been kept for further mineralogical work.

The experimental work on the value of adding soluble manganese compounds to the local wheat lands was finalised this year, forty-seven soils from Chapman State Farm and private farms being examined for manganese. The amounts ranged from 0.0275 per cent. to 0.090 per cent. of HCl soluble Mn. A report dealing with this matter will appear in the West Australian Agricultural Journal during 1933.

The Animal Nutrition Officer submitted 12 soils in connection with the wasting disease of stock in the Denmark district. These were taken from affected and non-affected holdings and were to be examined for mechanical and chemical properties, also acid soluble (HCl) and citric acid soluble Cu, Mn, and Fe; portion of this work has been finished and the balance will be reported in 1933. Dr. Dunne, the officer in charge of the pasture improvement investigation, submitted eight soils from the Mount Barker district for chemical analyses. The Forestry Department, through their soils officer, submitted 64 soils. Of these 34 were type samples for detailed examination, and the balance were taken from the pine nursery at Mundaring.

Fertilisers.—The Inspector of Fertilisers submitted 22 official samples during the year, all of which complied with the regulations. Twelve samples were received from private sources, one being bleached whale bones, collected on the North-West coast of this State. These had been ground fine and were to be sold as whale bone dust; they contained:—

Nitrogen (N), 2.49 per cent.

Total phosphoric oxide (P_2O_5), 22.01 per cent.

Another sample was from a fertiliser manufacturer who was mixing digester liquid with wood ashes. He considered that it was a very strong fertiliser because the workmen could not get near the grinding and mixing mill owing to the strong smell of ammonia that was given off. This material contained only 0.28 per cent. nitrogen. The balance were from farmers, etc., who thought that their consignments of manures did not come up to the guarantee supplied by the manufacturer. This idea was found to be incorrect in each case.

Fungicides and Insecticides.—The twenty samples received under this heading were for registration purposes, the Agricultural Department requiring a certificate of analysis as a check on the formula supplied by the manufacturer before the material can be placed on the local market. In a number of cases the analysis did not agree with the percentages of active ingredients declared by the vendors.

Fodders.—Of the 22 fodders received twelve were in connection with a stock disease at Gingin; this will be dealt with under mineral deficiency diseases in stock. The balance of the samples included two pasture samples from Moora for general analyses, two from Denmark for iron estimation, and two linseed meals. Others were a sample of oaten husk, a poultry meal and two native beans in their pods that are stated to be relished by stock. Unfortunately, except that the beans belonged to the Acacia family, the Government Botanist could not identify them. The beans were marked "Standback" and "Snakewood."

Limes, etc.—Only 14 samples came under this heading; of these the Metropolitan Water Supply submitted three in which the free lime ranged from 64 to 78 per cent. Five samples of burnt lime were sent in by private firms for free lime estimation, this figure ranged from 69 to 82 per cent.

Waters.—The total number of waters received during the year was 718, of which the Metropolitan Water Supply accounted for 406. Rain water samples numbering 39 were taken during the months of May and August from the catchment areas at Churchman's Brook, Wungong, and Canning to be tested for salinity. The chlorine figure found ranged from 1.3 to 31.5 parts per million. Samples are taken twice a week from the inlet and outlet pipes at the King's Park reservoirs for pH test. Every quarter an hygienic analysis is made on the different sources of water that provide the mixed water supplied to the metropolitan area. These are taken from streams, bores, reservoirs, and underground drives. A check is also kept on the quantity of free chlorine remaining in the water after it has been chlorinated. The quality of the water as supplied is consistently good.

Chemical analyses were made of samples from the new twin bores at King's Park, and also the bore at the Belmont racecourse, the figures found being as follow:—

Locality	King's Park	Belmont Racecourse
Depth, feet	2275	1,109
	Parts per million.	
Ferrous carbonate	Trace	18
Calcium carbonate	90	27
Magnesium carbonate	55	39
Sodium carbonate	5	...
Calcium sulphate	...	...
Magnesium sulphate	...	5
Potassium sulphate	18	...
Sodium sulphate	55	19
Sodium nitrate	1	3
Sodium chloride	1,208	295
Potassium chloride	...	15
Aluminium oxide	5	Trace
Silica	2	2
Total	1,439	423
Temperature	98° F.	84·4° F.
Reaction	8·2 pH	6·9 pH
Hydrogen sulphide	*Nil*	Present
Total hardness	156	77

One of the bores in King's Park is the deepest in the metropolitan area.

Samples of water from Mundaring reservoir and Kalgoorlie reticulation are forwarded every quarter

by the Department of Works for hygienic analyses, the water proving to be of good potable quality. This Department also sent in 73 samples of water taken from different parts of the State for complete chemical or partial analyses.

As is always the case, a large number of waters are received from farmers, stock owners, etc., for analyses as to their suitability for stock or irrigation purposes. Of the number received (187) a proportion were too saline to be of any value at all.

Sewage.—Quarterly samples totalling 44 were received from the treatment works at Perth, Subiaco and Fremantle. The figures obtained indicate that the tanks and filter beds are working satisfactorily.

Mineral Deficiency Diseases in Stock.

Denmark.—Apart from 12 soils for detailed chemical work, and two fodders for the estimation of iron, no further chemical work has been received from this district.

Gingin.—In connection with the sheep disease in this district four samples of water, six specimens of lambs' blood, and 12 fodders were examined. A record of the figures obtained from the bloods may be of interest. They are as follow:—

Lab No.	217	207	208	209	167	168
Lamb No.	15	16	17	18	19	20
	Grams per 1,000 grams of blood.					
Chlorine (Cl)	3·407	not det.	3·327	3·280	3·215	3·294
Sodium (Na)	2·546	2·635	2·706	2·646	2·529	2·548
Potassium (K)	·297	·313	·327	·323	·287	·267
Calcium (Ca)	·0773	·0716	·0762	·0901	·0796	·0750
Magnesium (Mg)	·0110	·0114	·0125	·0122	·0130	·0132
Total, phosphorus (P)	·1682	·1575	·2068	·2068	·1812	·1907
Inorganic phosphorus (P)	·0403	·0453	·0391	·0492	·0382	·0536
Organic phosphorus (P)	·1279	·1122	·1677	·1576	·1430	·1371

Specific gravity averaged 1·035.
Lambs, Nos. 15 to 18 affected. Lambs Nos. 19 and 20 normal, 6 months old. No. 16 had clotted badly and No. 20 partially, this would probably affect the P and Cl figures.

The fodders were samples that had been examined in 1931. Further investigation was asked for as to the percentage of Cu, Mn and As in them. The figures ranged from 9-50 parts per million for copper; 31-214 for manganese; and a trace to 1.5 for arsenic.

An interesting point that arose during the year could quite well be placed under the heading of mineral deficiency in stock. It had to do with the use by some stock owners of ferruginous clay as a lick for their animals. When damped down it is stated to be readily licked by the stock. Two of these clays on analysis gave the following figures:—

Lab. No.	2515	2539.
HCl soluble iron (Fe) ...	9·63%	3·24%
Water soluble salts... ...	·034	·092
Sodium chloride (calculated from chlorine)	·004	·010
Reaction	6·89 pH	7·27 pH

As there did not seem to be anything of nutritive value in the clays, it was suggested by an officer in the section that a small and variable proportion of the iron might be soluble in the gastric juices of the animals. To try this out a solution of hydrochloric acid was made of a strength approximating that of the gastric juices of animals (average figure 0.385 per cent. HCl). Figures for available iron were obtained by digesting 1 part of soil or clay with 50 parts of this acid at blood heat for three hours. Using the two clays and the 12 soils received from Denmark, the following figures were obtained:—

Lab. No.	Sample.	Incidence of Disease.	Available Iron.	Clay in Soil.
2515	Clay ...	...	0·135%	...
2539	Clay ...	...	·030	...
142	Surface soil...	Affected blocks	·016	11·5%
143	Sub soil ...	do. ...	·015	16·8
144	Surface soil...	do. ...	·019	23·9
145	Sub soil ...	do. ...	·013	34·3
146	Surface soil...	do. ...	·019	17·5
147	Sub soil ...	do. ...	·015	41·0
148	Surface soil...	Healthy blocks	·009	12·3
149	Sub soil ...	do. ...	·078	16·1
150	Surface soil	do. ...	·039	18·8
151	Sub soil ...	do. ...	·018	40·9
152	Surface soil...	do. ...	·015	6·0
153	Sub soil ...	do. ...	·020	7·2

Stock when grazing pick up small quantities of soil containing varying amounts of iron soluble in the gastric juices. As iron deficiency has been suggested as a cause of the Denmark wasting disease, this matter may be of interest.

Removal of salt from soil by native vegetation.—Samples of leaves, bark, sapwood and heartwood of local timbers, totalling 24 in all, were received from the Department of Agriculture with a view to ascertaining the amount of total chlorides present. These specimens were taken from trees growing on land containing considerable amounts of salt. The highest figure found for the leaves was 1.035 per cent. sodium chloride (on dry basis); these were from the Red Morrell (*Eucalyptus longicornis*). For the bark 0.475 per cent. sodium chloride was the highest figure obtained; for the sapwood 0.286 per cent.; and for the heartwood 0.228 per cent.. these were all from the Yorrell (*E. gracilis*).

Dandaragan lime and phosphate deposits.—In connection with Dr. Simpson's investigation of the above deposits, samples to the number of 29 were examined. They comprised waters, soils, phosphate pebbles and rocks, glauconitic sand and chalk. The results will be found in a report by Dr. Simpson in the *Journal of Agriculture*, W.A., Vol. 9, No. 3, September, 1932, page 420.

Bran and pollards.—All of the 31 official samples of bran and pollard received failed in some respects to comply with the standards set down under the regulations for moisture, fibre, ash and fineness.

Flour.—With the exception of the analyses of flours obtained from the different milling tests in our own laboratory, very few flours (5) have been received from private sources. Of these three were in connection with British War Office contracts.

Wheat.—Three hundred and thirty wheat samples were received during the year. The nitrogen fertiliser experiments conducted by the Agricultural Department accounted for 180. This work has now been finalised and a report will probably be published by the Department some time during 1933. Thirty wheats from the experimental farms, 10 Gluclub variety samples, 12 for export to Japan, 4 f.a.q. standards, and 68 for the Royal Agricultural Society

made up the number that were to be milled and an analysis of the flour made. In addition to this, 16 wheats were received for moisture test in connection with the bulk handling of wheat.

The collection of f.a.q. wheats from each State was continued this year, and an analysis was carried out on each one, as in previous years. The following figures were obtained for the f.a.q. samples:—

Lab. No.	1734.	1735.	1736.	1447.
State	New South Wales.	Victoria.	South Australia.	Western Australia.
Bushel Weight—				
Declared (lbs.)	61½	62¾	61½	61¾
Original (lbs.)	61⅞	63¾	63⅛	62¼
Cleaned (lbs.)	62¼	64½	63⅞	63¼
Moisture (per cent.)	9·4	10·0	8·2	9·0
Weight of 1,000 grains (grams)	43·76	39·52	41·67	37·45
Wheat protein (per cent.)	10·61	10·29	10·97	10·00
Wheat ash (per cent.)	1·59	1·40	1·51	1·42
Products—				
Flour (per cent.)	70·7	70·0	71·1	71·0
Bran (per cent)	20·3	20·7	19·7	19·3
Pollard (per cent.)	9·0	9·3	9·2	9·7
Flour—				
Moisture (per cent.)	13·60	13·16	13·65	11·60
Strength (per cent.)	54·0	55·5	54·5	55·0
Ash (per cent.)	0·65	0·60	0·70	0·56
Protein (per cent.)	9·22	8·82	9·78	10·80
Gluten (wet) (per cent.)	29·21	*	28·07	29·25
Gluten (dry) (per cent.)	10·40	*	9·95	10·12
Colour	Very good	Very good	Very good	Very good

* The gluten figures for the Victorian flour were unobtainable as the gluten dispersed under washing conditions.

The grain moisture was determined on cracked grain, being the loss of weight in one hour at 130deg. C.

Royal Agricultural Society Exhibits.—The number of wheats submitted this year was 68, representing 76 entries, some of these have been entered for the World Grain Exhibition to be held in Canada during 1933. Of the total entries 49 were selected by the judges, after a preliminary examination, on the basis of the general appearance of the grain, bushel weight and trueness to type. These were milled and an analysis of the flour made. Points are awarded for flour yield, strength, flour protein and colour, which are taken in conjunction with the calculated yield of pounds of bread per ton of wheat. Prizes are awarded accordingly. The Champion wheat this year was an excellent sample of Comeback, grown at Three Springs, the total number of marks gained being 98.75.

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 Co.

A. J. HOARE, A.A.C.I.

DIVISION VIII.

Report of the Chief Inspector of Explosives for the Year 1932.

The Under Secretary for Mines.

I have the honour to submit, for the information of the Hon. the Minister for Mines, in compliance with Section 45 of "The Explosives Act, 1895," my report on the working of the Branch for the year 1932.

The importations of explosives show a marked increase on those of the previous year. Eight shipments were received, and on submitting samples taken from these consignments to the official tests, they all proved satisfactory, they also give reasonably high velocity of detonation results in tests made by the "Deutriche" method. All figures obtained by these tests on explosives during storage in the magazines at Woodman's Point were above the figure recommended in the report made on the efficiency of explosives in 1929, namely, 1,500 metres per second. Satisfactory and efficient results, therefore, should have been obtained with the proper use of the explosives as liberated for consumption.

Table No. 1 shows the quantities of the various explosives imported into the State during the year:—

TABLE 1.

Importations of Explosives into Western Australia during 1932.

Explosive.	Quantity in lbs.
Gelignite	1,067,250
Gelatine Dynamite	617,200
Blasting Gelatine	335,600
Permitted Explosives	38,050
Powder—Blasting and Pellet...	136,875
Total	2,194,975
Detonators, No.	2,370,000
Fuse, yards	2,880,000

Table No. II., hereunder, 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.

Explosives.	1928.	1929.	1930.	1931.	1932.
	lbs.	lbs.	lbs.	lbs.	lbs.
Gelignite	640,000	337,000	413,500	565,500	1,067,250
Gelatine Dynamite	487,500	405,000	447,000	575,250	617,200
Blasting Gelatine	127,500	233,500	220,000	145,150	335,600
Permitted Explosives... ...	57,000	47,500	61,000	20,000	38,050
Powder, Blasting and Pellet ...	152,250	207,500	150,000	90,725	136,875
Totals	1,464,250	1,230,500	1,291,500	1,396,625	2,194,975
Detonators, No.	1,480,000	975,000	1,075,000	1,805,000	2,370,000
	Coils.	Coils.	Coils.	Yards.	Yards.
Fuse	202,500	213,000	232,500	1,987,200	2,880,000

In Table No. III. is set out the distribution of explosives in the different classes of industry, and it will be noted that the high percentage is being maintained in the quantity used in gold mining:—

TABLE III.

Distribution and Consumption of Explosives for years 1931 *and* 1932.

	1931.		1932.	
	Lbs. used.	Percentage of total.	Lbs. used.	Percentage of total.
Gold Mining	1,320,700	90·98	1,767,200	91·16
Agricultural and land clearing	36,400	2·50	30,600	1·58
Government Departments, including Railways, Public Works and Water Supplies	29,650	2·04	73,300	3·78
Quarrying	37,150	2·56	44,100	2·28
Lead Mining	150	0·01	...	...
Coal Mining	27,350	1·87	23,300	1·20
Tin Mining	200	0·01	...	...

Licenses issued for the storage and sale of explosives are given in Table No. IV.:—

TABLE IV.

Licenses issued during 1932.

For Magazines on Government Reserves	45
For Magazines used by Government Departments	36
For Magazines erected on private property ...	44
Store Licenses :—	
Mode (a)	99
Mode (b)	2
Fireworks only	230
Importation licenses	2

Inspections of licensed magazines and stores have been made throughout the metropolitan area, and where possible throughout the country districts, the number of inspections being 104. It was not found necessary to take proceedings for any breaches of the Act or Regulations for the storage and transport of explosives.

The following Table, No. V., gives the quantities of explosives it was found necessary to destroy as being unfit for consumption:—

TABLE V.

Destruction of Explosives during 1932.

Date.	Place.	Kind and Quantity.	Remarks.
26–1–32	Claremont Hospital for Insane	3lbs. Gelignite	Chemical deterioration.
18–2–32	Bridgetown	600 Detonators	Damaged by water.
3–3–32	York	100 detonators	Damaged by water.
15–3–32	Narrogin	1lb. gelignite	Chemical deterioration.
19–5–32	Clackline	5lbs. gelignite	Chemical deterioration.
16–6–32	Woodman's Point ...	14 plugs Viking powder	Damaged by water.
		5lbs. gelignite	Damaged by water.

The following tests, Table VI., were made with a view to the determination of the chemical purity and stability of explosives imported and stored in this State:—

TABLE VI.

Tests of Analyses made during 1932.

Heat Tests	1,002
Analyses of explosives	22
Fuse tests	294
Fireworks tests	39
Velocity of detonation	62
A.D.C. tests	20
Detonator tests	60
Miscellaneous	11

There were no explosives added to the authorised list during the year.

I desire to acknowledge the courtesy of the Commissioner of Police and his officers for the assistance they have given the Department during the year.

T. N. KIRTON,

Chief Inspector of Explosives.

7th April, 1933.

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