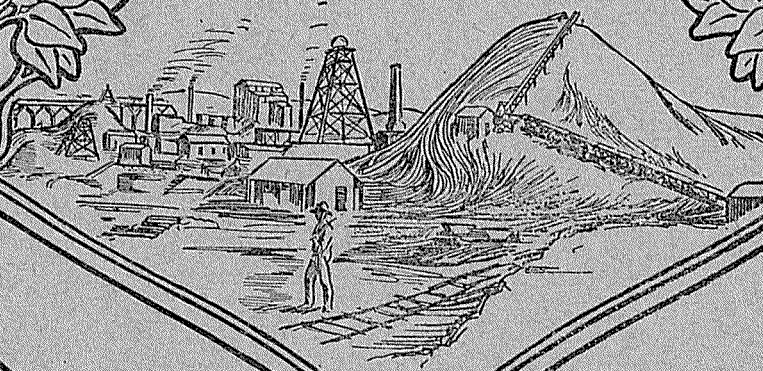




REPORT
OF THE
DEPARTMENT OF MINES
FOR THE YEAR
WESTERN · 1935. · AUSTRALIA



PRESENTED TO BOTH HOUSES OF PARLIAMENT

BY HIS EXCELLENCY'S COMMAND



J. D. Higgins

1936.

—
WESTERN AUSTRALIA.

REPORT

of the

Department of Mines

FOR THE YEAR

1935.

PERTH:

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1936

ANNUAL REPORT OF THE DEPARTMENT OF MINES, WESTERN AUSTRALIA, 1935.

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STATE OF WESTERN AUSTRALIA.

Report of the Department of Mines for the State of Western Australia for the year 1935.

To the Hon. the Minister for Mines.

Sir,—

I have the honour to submit the Annual Report of the Department for the year 1935, together with reports from the officers controlling the sub-departments, and comparative tables furnishing statistics relative to the Mining Industry.

I have, etc.,

M. J. CALANCHINI,
Under Secretary for Mines.

Department of Mines,
Perth, 31st March, 1936.

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 1935.

The estimated value of the mineral output of the State for the year was £3,174,266; an increase of £57,550 over the year 1934, calculating fine gold at £4 4s. 11.45d. per ounce. To the first figure must be added the sum of £A2,945,165, being the estimated premium on gold produced, to arrive at the actual value in Australian currency.

There were increases in the quantities and values of arsenic, coal, felspar, glauconite, silver and tin and in the value of tantalite exported, whilst an increased quantity of gypsum, of a lower value, was produced. The quantities and value of asbestos and gold and quantity of tantalite declined and no production of alunite, silver-lead ore, ochre and pottery clay was recorded. The marked increase in the value of coal was enhanced by a re-adjustment in the price payable.

The normal value of the gold yield was £2,756,984, being 86.86 per cent. of the total output value. (See footnote to Table 1, Part II.) The values of the other minerals were:—Coal, £318,013; Arsenic, £54,132; Silver, £12,687; Tin, £8,829; Felspar, £7,928; Gypsum, £6,888; Tantalite, £4,780, and Glauconite, £1,540.

Dividends paid by Mining Companies amounted to £1,090,456, in comparison with £876,025 in the preceding year. In addition, £34,462 were paid as a

bonus and in profit-sharing notes. (See Table 6.) To the end of the year 1935 the total amount distributed by Gold Mining Companies in dividends was £31,838,792. To the same date the value of the mineral production totalled £190,059,143, of which the gold production accounted for £175,680,539 based on normal values; but premiums from sales of gold during 1920-1924 and 1930-1935 and payments under "The Gold Bounty Act, 1930," increased by £13,419,653 the total values of mineral and gold productions respectively.

GOLD.

The gold yield showed a decrease of 2,289 fine ounces when compared with 1934, attributable to the cessation of production during the industrial dispute in the early part of the year.

The estimated average value per ton of ore treated in the State as a whole decreased from 30.66 shillings per ton in 1934 to 29.26 shillings per ton in 1935, calculated at the rate of £4 4s. 11.45d. per ton, but the premium obtained for gold during the 12 months (averaging 106.83 per cent.) would more than double this estimate. In the East Coolgardie Goldfield (which produced approximately 47½ per cent. of the State's reported yield) the estimated average value of the ore treated fell from 31.51 shillings to 28.95 shillings per ton. The estimates for the East Murchison (Wiluna Gold Mines), Mt. Margaret (Sons of Gwalia and Lancefield Mines), and Murchison Goldfields (Triton and Mt. Magnet Mines) were 20.60, 31.15 and 25.97 shillings respectively.

The reported tonnage of ore treated in 1935, 1,909,832 tons, showed an increase of 136,901 tons over the 1934 production.

The following goldfields reported increased tonnages of ore treated:—Murchison (66,519), Mt. Margaret (41,865), Dundas (23,653), Broad Arrow (10,224), Yalgoo (8,485), Coolgardie (5,054), Pilbara (2,032), East Coolgardie (1,075), North Coolgardie (224), and Ashburton (204), whilst East Murchison, Yilgarn, Peak Hill, Phillips River and North-East Coolgardie showed decreases of 14,909, 3,848, 2,748, 864 and 531 tons respectively.

Although the quantity of gold recorded as being received at the Perth branch of the Royal Mint and exported in concentrates and other gold-bearing material was less by 2,289 ounces than in 1934 (*vide* Table 1) the reported yield, from the tonnage of ore treated, exceeded that of 1934 by 6,279 ounces (*vide* Table 3). The average tonnage of ore raised per man employed and the average number of ounces of gold produced showed a falling off, as elaborated in Table 4.

Of the 17 goldfields listed in Table 3, ten reported increased gold yields: Murchison (18,603 ozs.), Mt. Margaret (14,164 ozs.), Dundas (6,577 ozs.), Broad Arrow (5,566 ozs.), Coolgardie (4,730 ozs.), Yalgoo (1,272 ozs.), Pilbara (1,093 ozs.), and Yilgarn (2,503 ozs.) being the principal contributors. The goldfields from which lower yields were reported were:—East Coolgardie (27,326 ozs.), East Murchison (16,992 ozs.), North Coolgardie (2,448 ozs.), Peak Hill (1,336 ozs.), and North-East Coolgardie (751 ozs.).

The acreage held under mining lease for all minerals is 82,509 acres, being an increase of 11,735 acres when compared with 1934. The area held for gold mining is greater by 11,851 acres and for other minerals smaller by 116 acres. The area held under prospecting areas is 62,702 acres, including 3,000 acres for coal. This is an increase of 3,440 acres on the area held in 1934. In addition to the area held under leases and prospecting areas there are many large reservations created under Section 297 of the Mining Act which are being actively prospected.

The average number of men engaged in mining was reported to be 15,557; an increase of 2,247 over the number reported for 1934.

The number of men engaged in the production of minerals showed an increase of 62. An increase of 65 men in the production of coal was reported, coincident with an increased coal output, the activity in the search for tantalite was reflected in an increase from 3 to 20 men, 7 more men were engaged in raising felspar and 6 more men were at work at Northampton on lead. Fifteen men less at Greenbushes seeking tin and 8 men less were required recovering the arsenic at Wiluna, being the principal decreases reported. No men were reported as being engaged in the production of alumite, ochre or pottery clay.

The number of men engaged in gold mining continues on the up grade, the increase over last year's figures being 2,185 men.

The estimated value of the average amount of gold produced per man employed in gold mining (calculated at normal value) was £217.02 in 1934 and £192.34 in 1935; a decrease of £24.68. The estimated average tonnage of ore raised per man was 133.37 tons, in the previous year 141.57 tons; a decrease of

8.20 tons per man, which may be ascribed to the number of men engaged in erecting plant and buildings being above the normal proportion.

The examinations of miners under the provisions of "The Mine Workers' Relief Act, 1932-1933," were continued during the year.

In the East Murchison Field there was a decrease of 16,992 fine ounces.

In the Black Range District there was an increase in the tonnage treated but the gold output showed a decrease. There was little prospecting in the outlying districts, largely consequent on the continued dry weather throughout the field.

At Barrambie, Berrigrin, Bellechambers and Currans Find only small numbers of prospectors were engaged but returns were reported from each.

At Errols the improved activity noted last year was not maintained and only a small production recorded.

At Hancock there was little change and a few crushings got out.

At Jonesville there was a good deal of activity and outputs were reported from the "Swan Bitter" and "North End" mines.

At Maninga Marley and Montagu only a few prospectors were employed and small outputs were reported from each.

At Nunngarra there were a few prospectors but no production worth noting.

At Sandstone there were several good crushings reported and a fair number of prospectors employed. During the year a 5-head battery was erected on the Black Range Trafalgar leases. An improvement generally during the coming year is anticipated. At Youanmi the old mine was acquired by an English company, the Youanmi Gold Mines, Ltd., and a large number of men has been engaged in erecting an up-to-date treatment plant capable of handling a large monthly tonnage. It is not expected to be completed until late in 1936. A good deal of activity is evident at this centre and the outlook is very promising. In the Lawlers district there was an increase in the tonnage crushed but a small decrease in the gold produced.

Crushings were reported from Kathleen Valley, Mount Sir Samuel and Lawlers. Mining throughout the district has shown increased activity. The Resolute Gold Mines, N.L., are operating the "Westralia" and "Vanguard" leases at Mount Sir Samuel and the Enn Gold Mines, Limited, have begun operations on the old Waroonga leases at Lawlers. At Kathleen Valley a mill on the "Nil Desperandum" has been fairly continuously employed.

In the Wiluna district there was a decreased output, mainly due to a temporary cessation of work at the beginning of the year consequent on an industrial dispute. Apart from this, the Wiluna Gold Mines, Ltd., was actively developing and producing at the big mine and additional plant was erected. The Bulletin mine is expected to produce a large monthly tonnage early in the new year.

On the property of the Moonlight Wiluna Gold Mines, Limited, a considerable amount of developmental work was done and plant erected. It is proposed to treat the ore from this mine at the plant of Wiluna Gold Mines, Ltd.

On the Starlight mine a good deal of diamond drilling and developmental work was done. On the Horseshoe Wiluna property a considerable amount

of prospecting work was carried out. Returns were reported from the outside centres of Cole's Find, Corboy's Find, Diorite, Gum Creek, Joyner's Find, Kingston, Mount Eureka, Mount Keith, Moilers Find, New England and Waldeck's Find. The outlook for Wiluna is exceedingly promising.

The Murchison field had an increase of 18,603 fine ounces, largely attributable to the commencement of milling operations by Mount Magnet Gold Mines, Ltd., at Mount Magnet, and the Triton Gold Mines, N.L., at Reedy.

In the Meekatharra district there was an increase. For the greater part of the year there was a good deal of mining activity in the neighbourhood of Meekatharra itself, but towards the close of the year there was a noticeable falling off in production. At the northern end of the township developments on the Havelock group of leases, which had been acquired by an English company, were not up to expectations and work ceased. On the main belt a lot of work was carried out and it is anticipated that there will be a big improvement soon. The State mill was fully occupied for practically the whole year. Crushings were reported from the outside centres of Belele, Bourke's Find, Bowie's Find, Burnakura, Chesterfield, Gabanintha, Garden Gully, Gum Creek, Holden's Find, Munarra Gully, Quinns, Ruby Well, Stake Well, Yaloginda and Wanganui; also from Nannine where the Aladdin Gold Mine is actively developing its property and has erected a considerable amount of plant. A lot of diamond drilling has also been carried out. Some prospectors reported good returns from this centre.

At Porlelle the Mars Gold Mines, Ltd., are erecting machinery on the old "Star of the East" mine and commenced unwatering after having carried out a lot of diamond drilling.

In the Cue district there was an increase. Outputs were reported from the outlying centres of Behring Pool, Cuddingwarra, Culculli, Belya, Mindoolah, Oliver's Patch, Reedy, Ryansville, Tuckabianna, Tuckanarra and Weld Range, as well as Cue itself.

The Premier Gold Mining Company was developing and sampling the Big Bell mine, over which it has an option, throughout the year. Indications are that the option will be exercised, and if so the immediate erection of a very large treatment plant is certain. At Reedy the Triton Gold Mines, N.L., commenced production in September after completion of the erection of plant and installation of a water supply. A good number of men is employed and the outlook is satisfactory. Many prospectors were working throughout the district but no new finds of importance were reported.

The State Mill was fully occupied throughout the year.

In the Day Dawn district there was a small decrease.

At Day Dawn the Western Mining Corporation did a vast amount of exploratory work on a reserve which included the old "Great Fingall" mine, but the results have not been made public. Great Northern Goldfields, N.L., have been developing and producing from some leases in the locality, and indications are that mining on a large scale will be undertaken.

At Lake Austin a couple of companies have been actively engaged.

At Pinnacles a good deal of prospecting was being done.

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

At Mt. Magnet production was commenced by the Mount Magnet Gold Mines, Ltd., and a large number of men employed.

The Hill 50 G.M. Co., N.L., are equipping the old Sirdar Mine with a 10-head mill and should be producing in a few months. Several other companies are also operating at this centre.

At Boogardie a good deal of activity was evident.

At Lennonville the Wheel of Fortune Gold Mines have been diamond drilling all the year. A treatment plant has been erected on the "Welcome" Mine and is also available for public crushing.

Several crushings were reported from this centre.

At Moyagee a good many prospectors were working and a few crushings were reported.

At Paynesville there was a slight falling off in the number of prospectors but some small crushings were recorded.

The Peak Hill Goldfield had a decrease of 1,336 fine ounces.

In the immediate vicinity of Peak Hill there was little change in the number of prospectors working and crushings were mainly from old leases. The State mill was running the whole year, some parcels treated coming from a considerable distance. Returns were reported from the outside centres of Jimble Bar, Mt. Padbury, and Mount Seabrook. At Jimble Bar the drilling done by the Western Mining Corporation did not give encouraging results and options were abandoned. The State mill only operated for a couple of months. At Mount Seabrook some very good returns were got, but owing to the entire absence of crushing facilities—the nearest battery being the State mill at Peak Hill, 90 miles away—progress has been retarded. As in other fields, the very dry conditions that prevailed considerably handicapped prospectors.

The Yalgoo field had an increase of 1,272 fine ounces. In the immediate vicinity of Yalgoo mining was very quiet and only a small output recorded. Productions were reported from Bilberatha, Carlaminda, Fields Find, Goodingnow, where much activity was existent and good returns obtained, Gullewa, Kirklucka, Messengers Patch, Noongal, Ninghan, Pinyalling, Retaliation, Rothsay, Wadgingarra, Warriedar and Yuin. Throughout the field mining showed steady progress.

The Mount Margaret Field had an increase of 14,164 fine ounces.

In the Mount Margaret district the principal event was the re-entry of the old "Lancefield" Mine into the field of producers. The mine has been equipped with a very up-to-date plant and the construction of a treatment plant to retreat the old dumps is in hand. A discovery in the Erlistoun district, known as "Cox's Find," gives great promise, and the property has been acquired by a strong company, which will proceed with the erection of plant at an early date.

The "King of Creation" Mine has been taken over by an influential company and it is expected will be vigorously developed.

At Cosmo-Newberry, Duketon, Burtville, Ida H., and the southern portion of the district a lot of prospecting was being done. In the Mount Morgans district the principal producer was the Westralia Mt. Morgans Mine. The company operating this mine also controls the Mount Margaret group of leases on which much development was done.

The V's United Mine was started up early in the year but after a little preliminary work the project was abandoned.

At Murrin Murrin the "Mosstrooper" Mine was worked continuously and, in addition to treatment of its own ore, crushed several parcels for prospectors. At this centre there was much activity. At Linden a lot of prospecting was being done and the local State mill, which is leased, was running almost continuously.

At Yundamindera, Eucalyptus, Pikes Hollow and Redcastle prospecting was active.

In the Mount Malcolm district the Sons of Gwalia Mine, as usual, produced the bulk of the output. This mine was vigorously developed and has a very promising future. The old "Harbour Lights" Mine and two adjacent leases were worked by the Leonora Central Company and some crushings raised. Towards the end of the year diamond drilling was done and the future policy of the company is contingent on the results. Drilling is also in progress on a Temporary Reserve on the north of the Leonora Central property. A public crushing plant will be operating at Leonora in the New Year, the Government having approved of financial assistance towards its erection for this purpose.

Crushings were reported from the outlying centres, Cardinia, Diorite King, Dodger's Well, Lake Darlot, Malcolm, Mertondale, Mt. Clifford, Pig Well, Randwick, Websters Find and Wilsons Patch. Two new finds were reported at 35-45 miles north of Darlot on the Wongawal Road, known as Corboys and Freemans. At Corboy's insufficient work has been done to assess the importance of the find, but it is stated that the outcrop dollied very high. Freeman's Find is located about three miles south of Corboy's. Several leases have been applied for and a very satisfactory crushing was raised.

The Coolgardie field had an increase of 4,730 fine ounces.

At Coolgardie the old Bayley's Mine is now held by Phoenix Gold Mines, Limited, and has been equipped with a winding and compressing plant. The company has unwatered it and done a large amount of diamond drilling and development. The Tindals Mine is being reopened by an English company and results should soon be known. From Bonnievale several crushings were reported, the largest production being from the "Melva Maie" lease. Various other shows contributed to the output.

From Bulla Bulling one crushing only was reported.

From Burbanks there were several crushings, including some fairly rich ones.

At Cave Rocks a fair amount of prospecting was done but the output was small. Returns were also reported from Coondarrie, Emu Well, Eundynie,

Gibraltar, Guarlbine, Grosmont, where prospecting was very active, Hampton Plains, Higginsville, where also a lot of prospecting was in evidence, Larkinville, Logan's Find, Londonderry, Love's Find, Mungari, Paris Group, Red Hill, Ryan's Find, Nepean Group, from where there were some rich crushings, and Wannaway. At Spargoville the Spargo's Find Gold Mines, Limited, did a lot of development work and plant erection, but progress is delayed pending the provision of an adequate water supply, the work in connection with which is now in hand. The company also produced the bulk of the output from this centre for the year.

At Widgiemooltha there was a good deal of activity and several crushings were reported.

At St. Ives there was little change, and the chief production was by a tributer on the Ives Reward Mine.

In the Kunanalling district there was an improved output and prospecting was active in most of the old centres. Outputs were reported from Barker's Find, Carbine, Chadwin, where several good crushings were raised, Chadwin Rocks, Dunnsville, Dunn's 8 Mile, Hawkin's Find, Kintore, where prospecting was fairly active, Kunanalling, London Group, Zuleika Group and Jourdie Hills.

The State battery at Coolgardie was crushing the whole year, but the one at St. Ives only intermittently.

The North Coolgardie field had a decrease of 2,448 fine ounces.

In the Menzies district there was much activity. On the old Lady Shenton considerable development work and diamond drilling was done. The erection of a treatment plant was also proceeding. Several small shows reported good crushings.

At Yundaga there was also increased activity and many good outputs recorded.

At Comet Vale considerable progress was made on the Sand Queen-Gladsome group and it is expected that the production stage will be reached early in the New Year.

At Mount Ida interest was maintained and the State Mill ran regularly on prospectors' ore.

The Ularring district was very quiet, the brightest centre being Davyhurst, where quite a number of prospectors were at work on various old holdings. Several good returns were reported.

At Mulline the Lady Gladys ceased operations.

At Mulwarrie there was a slight improvement and a few returns reported.

At Riverina the Riverina Gold Mines carried out extensive development work and diamond drilling, in addition to erecting considerable hauling and power plant. It is asserted that the outlook for this old mine is very bright. A few returns were also reported from this centre.

In the Yerilla district the Paget Mines, Ltd., had commenced operations on the old line of reef. Considerable plant was in course of erection and extensive underground work and diamond drilling done. At Welsh's Find the Chateau Tanunda leases were acquired by the Edjudina Gold Mining Co., N.L., and a treatment plant was being erected. It is expected that treatment will commence at an early date.

At Patricia the principal leases were being worked by tributers.

At Yilgarn the Yilgarn Queen reported an excellent crushing.

Yarri was very active and a large number of parties were working and having crushings put through at the local State Battery.

Yerilla was very quiet and only a small return was reported.

In the Niagara district a good deal of work was being done at Kookynie, principally by the Western Mining Corporation. Some good returns were reported also from Niagara and Tampa, where there were a good number of prospectors.

The North-East Coolgardie Goldfield had a decrease of 751 fine ounces.

Nothing of note was reported from this field. The only mine operating actively was the Golden Feather, which had an output of slightly over 300 fine ounces. A few other mines reported small productions.

At Gindalbi and Mulgarrie only a few prospectors were working. At Whitehead's a good return was reported from a prospecting area.

In the Kurnalpi district matters were quiet, excepting that at Jubilee there was a slight improvement, a couple of good crushings being recorded.

The Broad Arrow Field had an increase of 5,566 fine ounces, the output being almost doubled. Throughout the field increased activity was noticeable. A number of companies were opening up old properties and prospects for the coming year are very bright. In the vicinity of Broad Arrow a good deal of prospecting was in evidence and the Golden Arrow Battery crushed regularly for the public.

At Bardoe the Wycheproof was again worked and had a good output. A couple of other properties also reported satisfactory outputs.

Cashmans attracted a little attention but very few payable crushings were reported. At Black Flag a good number of tenements were held but nothing of interest was reported. A private battery was crushing public ore regularly.

At Fenbark and White Horse only a few prospectors were operating.

At Ora Banda considerable improvement was manifest.

A large amount of capital was made available for work on the old Associated Northern group and other properties were being actively opened up.

The State Mill ran almost continuously during the year.

At Grant's Patch there was considerable progress.

The Ora Banda Mines, N.L., reported a substantial production. The Dundas Gold Mines and Bent Tree Lease as well as several other smaller holdings reported payable returns. Waverley was fairly active and a number of rich discoveries reported but none of a permanent nature. Crushings were also reported from Paddington, Riches' Find and Windanya. At Smithfield only a few men were at work and from this and other small centres nothing of interest was reported.

In the East Coolgardie Field the number of men engaged in mining was 3,565, and in 1934, 3,519; an increase of 46, but the cessation of operations during the first quarter of the year materially reduced the average for the twelve months.

This goldfield gave employment to over 24 per cent. of the number of men engaged in gold mining and the reported production for the year was 306,949 fine ounces, over 47 per cent. of the total reported yield. The tonnage treated was 900,836 tons, being 1,076 tons greater than in 1934. The yield shows a decrease of 27,326 fine ounces on the preceding year, attributable to the cessation of work for a period of six weeks in the early part of the year, consequent on an industrial dispute. The average grade per ton of the ore treated fell from 31.51 shillings in 1934 to 28.95 shillings in 1935. The Lake View and Star Mine was again the chief producer. Developments on this mine have been very satisfactory and on the surface big improvements are being continually made and large expenditure incurred. The Great Boulder, on which a new plant has been erected, continued a steady producer. On the Boulder Perseverance developments were good and on the surface a new plant to be operated by a separate treatment company is nearing completion. From the South Kalgurli Consolidated there was an increased output and work proceeded steadily. The North Kalgurli had a very good year and is looking well in all sections. On the North Kalgurli United a large amount of diamond drilling and shaft sinking was done and it is stated developments were encouraging. The Paringa mine did a good deal of opening up levels and got out several trial parcels. It will probably erect its own treatment plant shortly. The Enterprise was working steadily and producing. The "Iron Duke" controlled by the Gold Mines of Kalgoorlie had a good production. The Western Mining Corporation did a large amount of drilling and investigatory work on the areas controlled by it. At the north end of the field the Hannans North was working continuously and developments were satisfactory.

At Hampton Plains the "Celebration" mine is being equipped with a new plant and developments are said to have been very satisfactory. This locality attracted more attention than for years past and several crushings were reported.

At Golden Ridge and Binduli a few men were working.

At Mount Monger there was considerable activity and many good crushings were reported. Lack of crushing facilities necessitates the ore being carted to Kalgoorlie for treatment, which is very expensive. There is likelihood of a plant being erected shortly. The State Mill at Kalgoorlie was kept fully occupied throughout the year.

In the Bulong district a good number of prospectors were operating and several crushings were reported, but nothing of note transpired.

The Yilgarn Field had an increase of 2,503 fine ounces. At Bullfinch the position was well maintained, the number of men employed and the gold produced being both in excess of the previous year.

At Corinthia there was about the same number of men employed, but a falling off in production. At Emmuin there was a slight improvement in both employment and production.

At Forrestania mining was still dormant. From the Golden Valley centre a good many crushings were reported and the "Radio" and "Radio Deeps" are reported to be opening up very well at depth.

At Greenmount there was only a small production from one mine, the "Transvaal North," and a few prospecting areas and claims. Diamond drilling is in progress on the old "Transvaal" mine by a strong English company.

From Holleton several crushings were reported, but the number of men employed was the same as in the previous year. The largest producers of ore were the "North End Extended" and the "North End." The local battery was idle for a considerable portion of the year consequent on a shortage of water. From Hope's Hill several crushings were reported and there was an increase in the number of men employed. At this centre there was considerable activity.

From Kennyville there were also several crushings and the total was in excess of last year. A 5-head mill, which will undertake public crushing, was erected at this centre.

At Koolyanobbing there was an increase in both production and men employed. A 2-head mill was also erected, which should be of assistance to prospectors.

At Marvel Loch there were considerable increases in both production and men employed.

The Marvel Loch Development, N.L., which holds a large acreage, did a considerable amount of underground development and was also erecting machinery. It is expected that production will commence early in the new year. The Great Victoria United, N.L., at Burbidge is about to erect a plant to treat a large monthly tonnage. Although its large ore bodies are low grade it is stated that treatment and handling costs will be kept at a figure that will enable work to be done at a profit. The Jacoletti Gold Mining and Battery Co., Ltd., erected a 10-head mill and did some public crushing. The Government assisted them financially in this project. Howlett's Battery, which also does public crushing, was operating continuously.

At Nevoria the main leases are held by the B.A.N.Z. Mines, Ltd. The leases have been actively developed and sampled and production is expected to commence shortly. The Yilgarn Gold Mine, N.L., completed the erection of a 5-head mill and had a small output. The property is a promising one.

At Edward's Find mining continued active and many crushings were raised. A 5-head mill was erected on one of the leases and crushing begun. This plant will be of great assistance to the locality.

At Mount Jackson a 5-head mill was erected by the Mount Jackson Gold Mines, N.L., and another known as the North Yilgarn Battery. The crushing requirements of this district should now be fully met. Several crushings were reported and there was an increase in the number of men employed.

At Mount Palmer the principal mine is Yellowdine Gold Development, Limited, on which a 20-head battery is in course of erection. It is expected that crushing will commence about April. Apart from this mine nothing of note has been discovered.

From Parker's Range several crushings were reported and there was an increase in the number of men employed. This is an attractive district to prospectors. From Mt. Rankin and Sandalwood Rocks, a new centre, only small returns were reported. In the Southern Cross centre there were increases in the output and men employed. Chief interest centred on the Southern Cross United Mines, Ltd., which holds large areas including the old "Frasers" mine and which has been doing a large amount of drilling and development work, but no treatment plant has yet been erected. The Yellowdine Gold Options is erecting a 10-head mill and a 3-head one has been erected on the "Sunshine" lease, also a 5-head transferred from Marvel Loch to the "Queen Anne" lease, so that ample crushing facilities should be available.

At Westonia there was a decreased production, consequent on the cessation of operations by the Princess Royal G.M. Co., N.L. The number of men employed showed an increase attributable to the re-opening of the Edna May (W.A.) Amalgamated Gold Mines, N.L., on which a 20-head battery has been erected. Production will commence so soon as the mine has been unwatered, which is proving a very big task. A new find was reported from a prospecting area at Boddalin Soak from which a good crushing was raised. The ore body is reported to be 14 feet wide and to have much promise.

The Dundas field had an increase of 6,577 fine ounces. This is largely attributable to increased production by the Norseman Gold Mines, N.L.

Other companies did a considerable amount of prospecting and developmental work, in particular the Western Mining Corporation. Its interests in the Phoenix, Cumberland Group, and Princess Royal Group are now held by a subsidiary company, the Central Norseman Gold Corporation, N.L., which has expended a large sum in opening up and developing them.

In the vicinity of Norseman several mines were actively working and producing.

Returns were also reported from Buldania, Dundas, Lake Kirk, the Cumberland Group, Peninsular Group, and Red, White and Blue Groups, where prospecting was very active. No return was reported from the Princess Royal, but a large amount was expended in the installation of plant.

The extension of the Goldfields Water Scheme to this field, now in hand, will be a great benefit to mining.

The State Battery was running almost continuously throughout the year.

The Phillips River field had an increase of 243 fine ounces. At Kundip the Beryl Mine was unwatered and a good deal of development work was being done; results are reported to be encouraging. Several other properties in the locality are also being worked. In the vicinity of Ravensthorpe a lot of prospecting is going on. At Hatter's Hill there was a good deal

of activity and prospects are encouraging. Generally speaking the outlook for this field is brighter than for some years.

The Pilbara field had an increase of 1,092 fine ounces. In the Marble Bar district crushings were reported from Bamboo Creek, Marble Bar, Lalla Rookh, Sharks Gully, Talga, Tambourah, Western Shaw, Warrawoona, Yandicoogina, and Twenty Ounce Gully.

At Marble Bar an improvement was shown, but the diamond drilling done on the Apex Mine did not give encouraging results.

At Bamboo Creek a good deal of investigatory work was being done by the North Australia Geological and Geophysical survey.

At Yandicoogina a crushing plant was erected on the "Uncle Tom" lease, but it is not known whether crushing has yet begun.

At Twenty Ounce Gully the "Expectation" lease had an exceedingly rich crushing, and it is stated has still a quantity of payable ore in sight.

In the Nullagine district returns were reported from Eastern Creek, Middle Creek, Mosquito Creek, Nullagine, and 20-Mile Sandy. Production from this district was greatly stimulated by the erection of a treatment plant at Mosquito Creek. The Government advanced a large sum towards this provision, which is available for public crushing. There are a good many prospectors at the various centres, but the absence of rain for a lengthy period has been a great handicap.

The State Mills at Marble Bar and Bamboo Creek were operating practically continuously during the year.

The Ashburton Goldfield recorded an output of 132 fine ounces, being an increase of 62 fine ounces. In this field there is only a little prospecting along the river and about Black Hill, where a party has erected a 2-head mill.

The Gascoyne Goldfield reported 25 fine ounces and in the previous year 71 fine ounces. A few prospectors round about Bangemall constitute nearly all the mining population in this field.

The Kimberley Goldfield had an output of 390 fine ounces, being an increase of 165 fine ounces.

At Hall's Creek renewed interest was being taken in the various parts of the district. Investigations were carried out, on behalf of English investors, on the old Ruby Queen group of leases. The entire absence of crushing facilities has always militated against prospecting in this remote field, but this is now being remedied to some extent by the Government loaning money for the erection of a 5-head mill and location of a water supply.

From districts outside the proclaimed goldfields productions were reported from West Pilbara, where the Weeriana Gold Mines, Ltd., were operating, Burracoppin, Donmybrook, Toodyay and Jimperdine.

TIN.

The quantity of tin exported was 60 tons, valued at £8,829; an increase in tonnage of 13 tons, and in value of £2,064. The production reported was one ton, valued at £80 from the Pilbara Goldfield, and 17 tons, valued at £2,360 from the Greenbushes Mineral Field.

The average number of men employed in the Greenbushes field was slightly lower than in the preceding year. The proposed boring for deep leads has not yet been undertaken.

TANTALITE.

Eight (8) tons valued at £4,780, were exported; a decrease in tonnage of 1 ton, but increase in value of £1,790.

The reported production was 7 tons, valued at £2,859, from the Pilbara Goldfield.

COPPER.

No copper was exported nor any production reported.

LEAD.

No lead was exported nor any production reported. In the Northampton Field, where it is mined, there was evidence of renewed activity and production will probably eventuate in the near future.

COAL.

The output of coal was 537,188 tons, being 36,845 tons greater than in 1934. The whole production was from the Collie Field, the deposits at Wilga not being worked.

The number of men employed, 689, was 65 more than in the preceding year, and the output per man was in 1934, 802 tons, and in 1935, 780 tons. There was little change at Collie during the year.

OIL.

Exploratory and geological operations have been carried out in both the Kimberley and Wooramul districts by well known geologists under the direction of the Freney Kimberley Oil Company, Ltd., and Oil Search, Ltd., respectively. Future operations will depend upon the recommendations made by these investigators.

ASBESTOS.

The reported production was 141 tons, valued at £2,889; a decrease in tonnage of 14 tons, and in value of £86, all from the West Pilbara district. The quantity exported was 168 tons, valued at £2,485; a decrease in tonnage of 2 tons, and in value of £116.

OTHER MINERALS.

The quantity of silver obtained as a by-product and exported was 79,879 ounces, valued at £12,687; an increase of 18,485 ounces, and in value £5,574.

Arsenic, 2,470 tons, valued at £54,132 (reported production 3,728 tons valued at £67,108) and Felspar, 2,660 tons, valued at £7,928 (reported production 4,208 tons, valued at £8,437). The production of 308 tons of Glauconite, valued at £1,540, and 5,461 tons of Gypsum, valued at £6,888 was also reported.

MINING GENERALLY.

The Western Australian gold production was 47.115 per cent. of the total for Australasia and Mandated Territory of New Guinea, and in the preceding year 51.94 per cent. With the exception of Tin and Tantalite, there was not any production of base metals.

In gold mining great activity was still maintained and although the gold output was slightly less than in 1934, there is not the least doubt that if the ces-

sation of work early in the year consequent on industrial troubles had not occurred there would have been a substantial increase. Next year should show a big improvement, as several mines are rapidly approaching the production stage. On many properties considerable expenditure is being incurred in the erection of up-to-date treatment plants and the industry is in a most healthy condition. The Government does everything possible to render assistance and keep it in a prosperous condition and any suggestions for further help receive the most sympathetic consideration.

The State Scheme for assisting prospectors was continued and the total number of men helped since inception to the end of 1935 was 2,800 for full assistance, which comprises ration orders to the extent of 15s. per week, rail passes and loan of tools, and 360 for loan of equipment only.

At the end of the year 250 were in receipt of sustenance and a further 380 using equipment. During the year they crushed 2,652 tons for 1,421 fine ounces. The expenditure was £15,267 11s. 9d. and refunds £4,520 6s. 11d. The cost since inception to the end of the year amounted to £80,430, while refunds from prospectors' crushings totalled £12,226.

At the commencement of the year the Commonwealth Government provided an amount of £62,000, to be operated under a fund known as the Commonwealth Metalliferous Fund, for the following specific purposes:—

- (a) Assistance to prospectors (£50,000).
- (b) Appointment of additional Technical Staff.
- (c) Erection of Batteries and Water Supplies.
- (d) Assistance to School of Mines to provide facilities for education of miners.

Under (a) 1,620 men were granted full assistance by way of 15s. per week sustenance, rail fares, and loan of tools, while 56 more were loaned tools and a further 12 assisted with rail passes. 3,396 tons of ore were crushed by these prospectors for a return of 1,282 fine ounces of gold. Apart from this many of them were enabled after some months' experience under the Scheme to obtain employment as miners.

Under (b) two additional geologists were engaged in the Geological Survey Branch.

Under (c) two batteries were erected at the request of mine owners, conditionally on their undertaking public crushing and the erection of two more has been commenced.

Under (d) an Assistant Lecturer, an Assayer and a Cadet were appointed to the School of Mines, and additional plant and technical books purchased.

The area held under prospecting areas for gold and minerals, apart from coal, viz.:—59,702 acres, is greater by 2,563 acres than in the preceding year.

Work in connection with the aerial geological and geophysical survey of the North of Australia undertaken by the Commonwealth, Queensland, and Western Australian Governments was proceeding satisfactorily.

The survey is controlled by a Committee of Ministers comprising Senator the Hon. A. J. McLachlan, Minister in Charge of Development (Chairman), representing the Commonwealth, the Honourable James Stopford and the Honourable S. W. Munsie, Minis-

ter for Mines, respectively of the States of Queensland and Western Australia. Sir Herbert Gepp, Consultant on Development to the Commonwealth Government, is the Director of the Survey and Chairman of the Executive Committee.

The operations of the Survey include aerial geological and geophysical surveying. The aerial photography is carried out by the Royal Australian Air Force. The Survey has a staff of geologists, which are formed into three parties for Queensland, Northern Territory, and Western Australia respectively. The Survey has its own staff of geophysicists, but has a contract with the Electrical Prospecting Company of Sweden for the supply of instruments.

During 1935, 1,000 square miles were photographed in each of the territories of Queensland, Northern Territory, and Western Australia respectively, the districts for photographing being selected by the Government Geologist of the Territory concerned. The Queensland districts included those of Cloncurry and Palmer River; in Northern Territory those of Eastern MacDonnell Range and Pine Creek; in Western Australia those of Bamboo Creek, Marble Bar, Warrawoona, and Nullagine in the Pilbara Goldfield.

Geological surveys were carried out by the respective parties in these districts.

Geophysical surveys were restricted to the Cloncurry district of Queensland and included the Soldiers Cap, Trekelano and Dobbyn areas, and to the Tennant Creek Goldfield, Northern Territory.

Results of the Survey include the following:—

GEOPHYSICAL.

Tennant Creek.—Magnetic survey of the Tennant Creek goldfield yielded a number of magnetic "anomalies" corresponding generally to outcropping bodies of magnetic iron ore but also revealing the presence of similar bodies which do not outcrop at the surface. In addition an exceptionally large magnetic "anomaly" was obtained, which is certainly of a very interesting nature and may prove to be of considerable importance. This "anomaly" indicates a large body of magnetic iron ore lying at a depth of approximately 300 feet below the surface. This "anomaly" has to be tested by drilling or shaft sinking to determine its economic importance. It is expected that other large "anomalies" will be found by the geophysical survey during 1936.

Trekelano and Dobbyn.—A number of electro magnetic "indications" were obtained in these areas which may correspond to auriferous copper ore bodies. Trial shafts are being sunk to test these "indications."

Soldiers Cap.—Electro magnetic "indications" were obtained in the Mount Freda and Canteen areas but have yet to be tested.

GEOLOGICAL.

Western Australia.—In connection with the Pilbara district in Western Australia the Survey reports that the Lalla Rookh, Bamboo Creek, and probably the Blue Spec areas include ore shoots, which warrant further investigation by small mining companies or strong financial syndicates. In the case of Lalla Rookh there are three shoots of ore aggregating 185 tons of ore per vertical foot with average values from

11.7 to 15.0 dwts. per ton. The mine has been developed to a depth of 150 feet and is already equipped with a battery. The Bamboo Creek field has produced by selective mining 54,679 ounces of gold from 33,625 tons of ore, which gives an average yield of 32 dwts. per ton. The Survey considers that increased production can be brought about by more satisfactory mining methods. The Blue Spec line of gold-antimony quartz veins forms part of a line of sporadic outcrops over a distance of at least 10 miles. The Blue Spec Mine contains an ore shoot 250 feet long, 8.5 feet wide, and averaging 11.7 dwts. of gold per ton and 1.4 to 2.8 per cent of antimony. The present possible ore reserves are 9,000 tons.

Attention is drawn to the Marble Bar and McPhee's Patch and North Pole deposits, which offer scope for mining by individuals and small parties. In these and in similar areas to be examined in 1936 by the Survey, the position regarding batteries, cheap transport, water supply, etc., will be investigated with a view to the encouragement of more economic mining development.

Northern Territory.—In the Claraville area in the Eastern MacDonnell Range a large number of short and narrow but rich quartz veins occur and offer opportunities for the operation of individuals and parties.

In the existing state of development the system in the Enterprise mine offers the best possibilities for mining, but at present on a small scale only.

Queensland.—In regard to the Cloncurry district, the Survey states that the known ore shoot of the Mount Freda reef affords opportunities for the operations of a small syndicate, and it is possible that further development may reveal other ore shoots. The Canteen reef and adjacent geophysical indications justify further work and it is proposed to test them further. The Survey recommends that the Gilded Rose ore shoot be tested by drilling.

The Victoria mine at Bower Bird contains a small auriferous ore shoot at present being tested and which may provide opportunities for development by a syndicate or small company.

1936 Programme.

The programme for 1936 includes the speeding up of the work of the Survey by increasing the area to be photographed and by strengthening the geological and geophysical staffs. The aerial photography carried out last year covered approximately 3,000 square miles. The Royal Australian Air Force will photograph an area of 9,000 square miles during the

coming season. This will probably include the Cloncurry, Croydon and Portland roads districts of Queensland; the Pine Creek Daly River, Tennant Creek, Arnheim Land and Jervois Range districts of the Northern Territory, and the Pilbara, West Pilbara, Kimberley, East Kimberley and Ashburton-Gascoyne districts of Western Australia.

These areas will also be geologically surveyed during 1936 as well as certain districts which were photographed during the 1935 season, but not geologically surveyed.

In regard to geophysical work in 1936, it is proposed to continue the survey in the Trekelano district in Queensland and the Tennant Creek area of the Northern Territory. Additional areas will be covered in the vicinity of Cloncurry, including Silver Ridge, Dugald River, and possibly Gilded Rose and the Great Australian-Block 14 mine, and later Mt. Oxide. Geophysical work will also be done at Pine Creek in the Northern Territory. The geophysical work will be extended to certain districts in Western Australia, including the Pilbara and West Pilbara and Kimberley districts.

The Committee of Ministers points out that the Survey is performing important functions in correlating geological and geophysical investigations in the field and in developing the proper relationship between these branches of economic geology; the Survey is advancing the knowledge in Australia of the use and the application of geophysical methods as a factor in the search for metallic minerals. In this regard, a considerable contribution is being made to the sum of existing knowledge. The Survey is also bringing into prominence the value of aerial reconnaissance and aerial photography as aids to geological survey operations.

The Survey is making a very important contribution to the development of the North. Private enterprise is manifesting a close interest in the work in all the districts in which operations have been carried out, and a valuable scientific organisation has been built up which should go a long way towards the acceleration of the development of this portion of Australia by means of mineral discoveries. The Air Force is also gaining considerable knowledge of this portion of the continent which will be of great value to Australia in the future.

The expenditure incurred in rendering assistance to mine owners and the industry generally under the provisions of the Mining Development Act totalled £44,791 6s. 5d., and in the preceding year £53,307 8s. 11d.

PART II.—MINERALS.

TABLE 1.

Quantity and Value of Minerals produced and/or exported during Years 1934 and 1935.

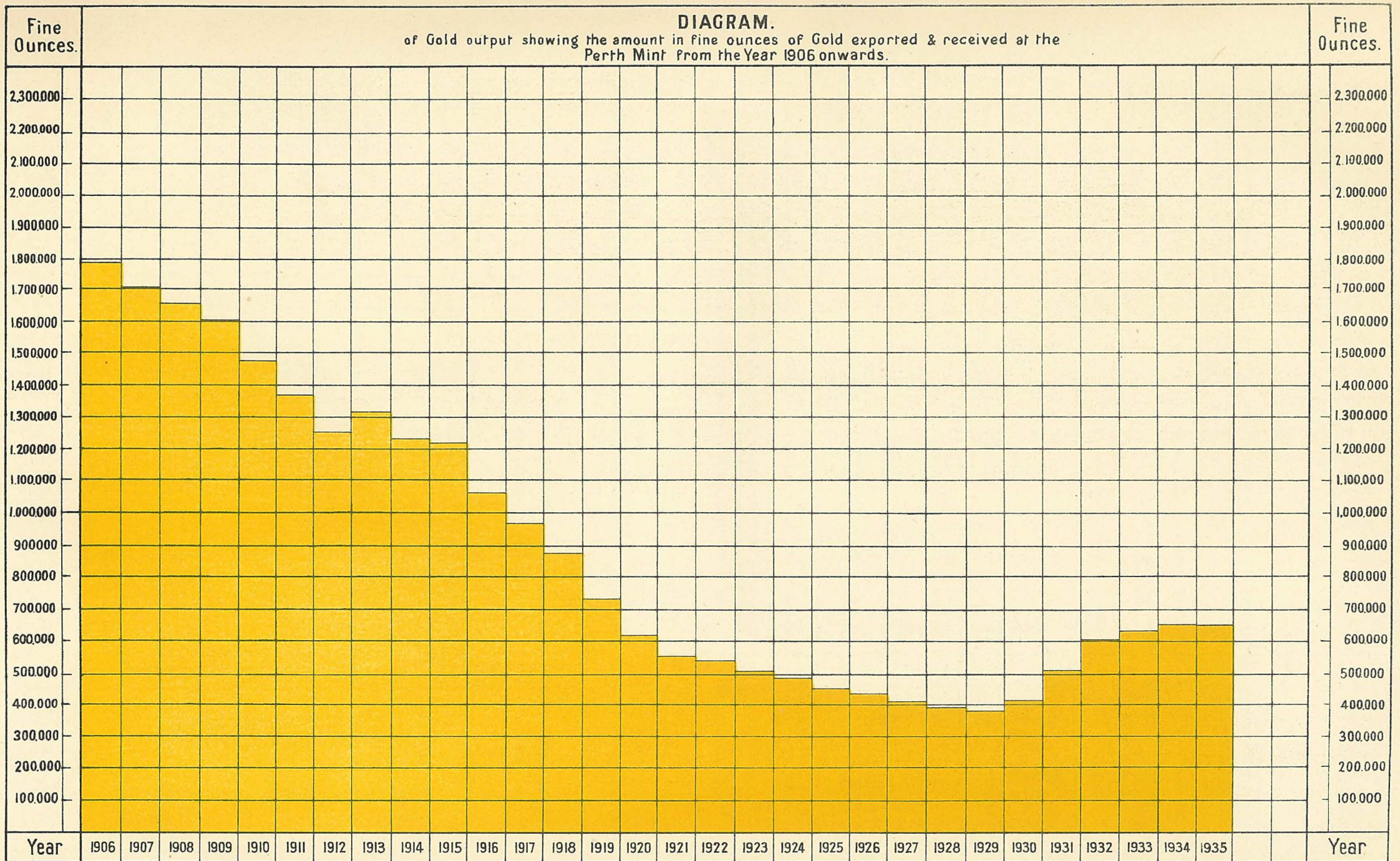
Description of Minerals.	1934.		1935.		Increase or Decrease for Year compared with 1934.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		£		£		£
1. Alunite (exported), statute tons	2	15	...	...	— 2	— 15
2. Arsenic (exported), statute tons	1,608	37,705	2,470	54,132	+ 862	+ 16,427
3. Asbestos (exported), statute tons	170	2,601	168	2,485	— 2	— 116
4. Coal (raised), statute tons	500,343	278,704	537,188	318,013	+ 36,845	+ 39,309
5. Felspar (exported), statute tons	1,816	5,482	2,660	7,928	+ 844	+ 2,446
6. Glauconite (reported), statute tons	240	1,200	308	1,540	+ 68	+ 340
7. Gold (exported and minted), fine ozs. ...	651,338	*2,766,708	649,049	*2,756,984	— 2,289	— 9,724
8. Gypsum (reported), statute tons	5,307	7,210	5,461	6,888	+ 154	— 322
9. Lead and Silver Lead (exported), statute tons ...	10	86	...	...	— 10	— 86
10. Ochre (reported), statute tons	26	68	...	...	— 26	— 68
11. Pottery Clay (reported), statute tons	55	69	...	...	— 55	— 69
12. Silver (exported), fine ozs.	61,394	7,113	79,879	12,687	+ 18,485	+ 5,574
13. Tantalite (exported), statute tons	9	2,990	8	4,780	— 1	+ 1,790
14. Tin (exported), statute tons	47	6,765	60	8,829	+ 13	+ 2,064
	...	3,116,716	...	3,174,266	...	+ 57,550

* Although there was a decrease in gold output and value in 1935 (when calculated at £4 4s. 11·45d. per fine ounce), there was actually an increase in value obtained when the estimated premiums paid to producers are taken into account, amounting to £A2,945,165 for 1935, as compared with £A2,792,165 in 1934.

TABLE 2.

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

Year.	Total Exports.	Mineral Exports (exclusive of Coal).	Percentage.
	£	£	
1902	9,051,358	7,530,319	83·20
1903	10,324,732	8,727,060	84·53
1904	10,271,489	8,625,676	83·98
1905	9,871,019	7,731,954	78·33
1906	9,832,679	7,570,305	76·99
1907	9,904,860	7,544,992	76·17
1908	9,518,020	7,151,317	75·13
1909	8,860,494	5,906,673	66·66
1910	8,299,781	4,795,654	57·78
1911	10,606,863	7,171,638	67·61
1912	8,941,008	5,462,499	61·09
1913	9,128,607	4,608,188	50·48
1914	8,406,182	3,970,182	47·23
1915	6,291,934	2,969,502	47·19
1916	10,878,153	6,842,621	62·92
1917	9,323,229	5,022,694	53·87
1918	6,931,834	2,102,923	30·34
1919	14,279,240	6,236,585	43·67
1920	15,149,323	3,096,849	20·44
1921	10,331,405	1,373,810	13·30
1922	11,848,025	2,875,402	24·27
1923	11,999,500	3,259,476	27·16
1924	13,808,910	1,424,319	13·24
1925	13,642,852	173,126	1·27
1926	14,668,184	1,597,698	10·89
1927	15,805,120	472,041	2·99
1928	16,911,932	996,099	5·88
1929	16,660,742	1,802,709	10·82
1930	19,016,639	6,370,396	33·49
1931	14,266,650	4,333,421	30·37
1932	16,771,465	5,657,870	33·74
1933	18,098,214	5,328,869	29·44
1934	16,784,705	5,759,324	34·31
1935	16,666,817	5,620,047	33·72
Total since 1902 ...	413,151,965	160,112,238	38·75



Note:— Previous to 1906, Gold Produced, 14,871,687 Fine Ozs.

Peak Year 1903 Gold Produced 2,064,801 " "

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.					
	1934.	1935.	Percentage for each Goldfield.		Average Value per ton of Ore treated. (Gold at £4 4s. 11.45d. per fine oz.)	
			1934.	1935.	1934.	1935.
	fine ozs.	fine ozs.			shillings.	shillings.
1. Kimberley	225	390	.035	.061	...	...
2. Pilbara	5,321	6,413	.832	.992	59.04	63.09
3. Ashburton	70	132	.011	.020	...	...
4. Gascoyne	71	25	.011	.004	...	...
5. Peak Hill	3,074	1,738	.481	.269	25.16	19.81
6. East Murchison	137,152	120,160	21.434	18.596	22.78	20.60
7. Murchison	26,494	48,097	4.141	6.979	27.12	25.97
8. Yalgoo	6,422	7,694	1.001	1.191	50.82	34.66
9. Mt. Margaret	50,779	64,943	7.936	10.051	31.68	31.15
10. North Coolgardie	13,462	11,014	2.104	1.704	75.08	61.77
11. Broad Arrow	8,071	13,637	1.261	2.111	48.88	50.14
12. North-East Coolgardie	2,918	2,167	.456	.335	64.35	60.64
13. East Coolgardie	334,275	306,949	52.241	47.504	31.51	28.95
14. Coolgardie	11,681	16,411	1.826	2.540	48.84	57.76
15. Yilgarn	25,989	28,492	4.062	4.410	48.44	58.14
16. Dundas	12,432	19,009	1.943	2.942	52.08	36.77
17. Phillips River	1,008	1,251	.158	.194	28.57	25.26
State generally	427	628	.067	.097	59.52	...
Totals and Averages	639,871	646,150	100.000	100.000	30.66	29.26

The total yield of State is as shown in Table 1, being the amount of the gold received at the Royal Mint, the gold exported in bullion and concentrates, and alluvial and other gold not reported to the Mines Department.

When comparisons are made as to the yield from any particular Field with the preceding year, the figures reported to the Department are used.

TABLE 4.

Average Quantities of Gold Ore raised and treated, and Gold produced therefrom, per man employed on the several Goldfields of the State, during 1934 and 1935.

Goldfield.	1934.				1935.			
	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	56.93	29.22	45.87	23.54	54.31	30.95	37.20	21.20
3. Ashburton ... ..	...	...	...	...	...	...	...	...
4. Gascoyne ... ..	...	...	...	...	...	...	...	...
5. Peak Hill	340.03	161.92	102.48	48.80	276.03	122.18	62.95	27.86
6. East Murchison	*554.84	309.18	*148.77	83.07	470.60	259.04	113.83	62.60
7. Murchison	132.15	54.04	43.22	17.67	211.35	94.02	62.72	27.90
8. Yalgoo	48.25	21.84	29.87	13.52	83.45	35.92	33.85	14.57
9. Mt. Margaret	256.70	120.89	96.35	45.38	249.85	130.06	91.07	47.41
10. North Coolgardie	40.55	18.38	36.58	16.58	33.37	16.25	23.77	11.58
11. Broad Arrow	41.82	18.89	26.20	11.83	66.97	32.18	37.53	18.03
12. North-East Coolgardie	42.47	16.51	34.75	13.51	34.50	14.88	21.52	9.28
13. East Coolgardie	440.84	255.69	163.78	95.00	430.82	257.09	146.49	87.42
14. Coolgardie	40.09	16.92	24.54	10.36	37.20	16.96	24.50	11.17
15. Yilgarn	154.68	76.82	88.40	43.90	91.49	45.50	59.09	29.38
16. Dundas	111.98	55.99	68.70	34.35	128.05	70.73	55.36	30.58
17. Phillips River	60.73	36.30	20.56	12.29	25.45	12.88	15.07	7.63
Total Averages	283.71	141.57	102.39	51.09	259.74	133.37	87.88	45.26

* 1934 figures amended.

TABLE 5.

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

—	Output of Gold.	Value.*	Percentage of Total.	
			Output of Commonwealth.	Output of Australasia
	Fine ozs.	£		
1. Western Australia	649,049	2,756,984	53·539	47·115
2. Victoria	87,609	372,139	7·227	6·360
3. New South Wales	50,102	212,820	4·133	3·637
4. Queensland	102,900	437,091	8·488	7·470
5. Papua	17,130	72,763	1·413	1·243
6. Tasmania	8,343	35,439	·688	·606
7. South Australia	7,333	31,148	·605	·532
8. Northern Territory	9,272	39,385	·764	·673
9. Mandated Territory of New Guinea ...	280,564	1,191,759	23·143	20·366
10. New Zealand	165,277	702,052	...	11·998
	1,377,579	5,851,580	100·000	100·000

* Exclusive of Premium.

TABLE 6.

Dividends, etc., paid by Western Australian Mining Companies during 1935 and Total to date.

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

Goldfield.	Name of Company.	Bonuses and Profit Sharing Notes.	Capital returned.	Dividends.	
				1935.	Grand total paid to end of 1935.
		£	£	£	£
Peak Hill	Various Companies ... ..	...	...	...	160,666
East Murchison	Wiluna Gold Mines, Limited ... ..	...	...	433,333	973,333
Do.	Various Companies ... ..	...	...	...	437,968
Murchison	do. do. ... ..	...	...	...	1,992,670
Mt. Margaret	Sons of Gwalia, Limited ... ..	...	...	81,250	1,372,238
Do.	Various Companies ... ..	...	...	...	376,213
North Coolgardie	do. do. ... ..	...	...	...	575,032
North-East Coolgardie	do. do. ... ..	...	...	...	89,854
East Coolgardie	Boulder Perseverance, Limited	21,962	...	31,198	*1,671,930
Do.	Golden Horseshoe (New), Limited ... ..	...	(c)	55,000	110,000
Do.	Great Boulder Proprietary G.Ms., Limited ... ..	...	...	58,332	6,333,881
Do.	Lake View & Star, Limited	(b)	...	280,000	853,000
Do.	North Kalgurli (1912), Limited ... ..	...	...	75,000	143,750
Do.	South Kalgurli Consolidated, Limited	(a) 12,500	(d)	31,250	658,751
Do.	Various Companies ... ..	...	...	...	14,927,489
Coolgardie	do. do. ... ..	...	...	...	339,495
Yilgarn	Princess Royal G.M. Co., No Liability ... ..	...	...	3,750	*13,100
Do.	Various Companies ... ..	...	...	...	517,899
Dundas	Norseman Gold Mines, No Liability ... ..	...	...	41,343	*68,898
Do.	Various Companies ... ..	...	...	...	222,625
		£34,462	...	£1,090,456	£31,838,792

(a) In addition to £62,500 in 1932-4. (b) £42,000 in 1934. (c) £55,000 in 1932. (d) £93,750 in 1932-33.

* Amended since 1934 report issued, the Dividends for 1934 being £92,533 less than previously stated.

TABLE 7.
Quantity and Value of Minerals, other than Gold, reported to the Mines Department during 1935.

Goldfield, District, or Mineral Field.	1935.		Increase or Decrease for Year as compared with 1934.	
	Quantity.	Value.	Quantity.	Value.
	tons.	£A	tons.	·A
BLACK TIN.				
Pilbara Goldfield (Marble Bar District)	1	80	— 10	— 1,346
Greenbushes Mineral Field	17	2,360	+ 15	+ 2,142
Total	18	2,440	+ 5	+ 796
ASBESTOS.				
State generally (West Pilbara)	141	2,889	— 14	— 86
GYPSUM.				
Dundas Goldfield (Norseman)	706	177	+ 706	+ 177
Yilgarn Goldfield (Yellowdine)	487	487	— 1,164	— 1,164
State generally (Baandee)	1,877	3,004	— 291	— 248
(Lake Brown)	441	197	+ 441	+ 197
(Woolundra)	1,950	3,023	+ 462	+ 717
Total	5,461	6,888	+ 154	— 321
FELSPAR.				
Coolgardie Goldfield (Coolgardie)	4,208	8,437	+ 4,015	+ 8,051
GLAUCONITE.				
State generally (Moora District)	308	1,540	+ 140	+ 340
TANTALITE.				
Pilbara Goldfield (Marble Bar District)	7	2,859	+ 6	+ 2,729
LEAD.				
Northampton Mineral Field ... ..	...	...	— 5	— 61
ALUNITE.				
State generally (Lake Campion) ... ..	...	...	— 2	— 15
OCHRE.				
State generally (Carbarup) ... ..	...	...	— 26	— 68
POTTERY CLAY.				
State generally (Goomalling) ... ..	...	...	— 55	— 69
ARSENIC.				
East Murchison (Wiluna)	3,728	67,108	+ 2,097	+ 37,751

The average number of men reported to be employed showed an increase of 62, the number engaged in winning coal being given as 65 more than in 1934. Other increases were recorded in number of men on tantalite (17), felspar (7) and lead (6), and decreases on tin (15), arsenic (8), asbestos (3) and no reports were received that any alunite, ochre or pottery clay deposits had been worked.

The quantity of felspar reported showed a considerable increase, accounted for by the inclusion of some production not notified in time for inclusion

in last year's figures. Production of gypsum was reported from two new centres, but only the holdings at Norseman were being worked at the end of 1935, and the output was practically the same quantity as in the previous year. There was an increase in the quantity of tin and tantalite reported.

The enhanced price obtainable for gold prevailed throughout the year, which makes for a more attractive proposition than mining for the baser metals and other minerals.

TABLE 8.

Quantity of Coal raised during 1934 and 1935, estimated Value thereof, Number of Men employed, and Output per Man.

Coalfield.	Year.	Quantity raised.	Estimated Value.	Men employed.		Quantity raised.	
				Above ground.	Under-ground.	Per Man employed under-ground.	Per Man employed above and under-ground.
		tons.	£			tons.	tons.
Collie	1934	500,343	278,704	124	500	1,001	802
	1935	537,188	318,013	146	543	989	780

The 1935 figures disclose increases in quantity of coal raised, estimated value and number of men employed, when compared with 1934, being 36,845 tons of coal, £39,309 and 65 men respectively. The adjustments made during the year in the price paid for coal affected the declared value of the output, to which the large increase in the value may be attributed. There was a decrease in the quantity of coal raised per man employed, *i.e.*, 12 tons per man employed underground and 22 tons per man employed above and underground when compared with 1934.

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, 1934 and 1935.

Description of Leases.	1934.		1935.	
	No.	Acreage.	No.	Acreage.
Gold Mining Leases on Crown Land	1,513	27,412	2,159	39,393
" " " Private Property	26	592	21	462
Mineral Leases on Crown Land	172	42,646	168	42,554
" " Private Property	5	124	4	100
Prospecting Areas	3,038	59,262	3,108	62,702
	4,754	130,036	5,460	145,211

The total number of leases held for mining purposes increased by 636 and the area by 11,725 as compared with the year 1934. The number of leases for Gold Mining increased by 641 and the area by 11,951 acres. The number of mineral leases decreased by 5 and the area by 116 acres.

For the year 1934 the number of Prospecting Areas held was 3,038 of a total area of 59,262 acres, including 2 areas of 2,123 acres for coal.

For the year 1935 the number of Prospecting Areas held was 3,108 of a total area of 62,702 acres, including 1 area of 3,000 acres for coal.

COMPARATIVE STATISTICAL DIAGRAMS

RELATING TO
OUTPUT AND VALUE OF GOLD AND OTHER MINERALS, LANDS LEASED FOR GOLD MINING
 IN WESTERN AUSTRALIA
 AND THE **GOLD PRODUCTION OF AUSTRALASIA** FOR THE YEAR 1935

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

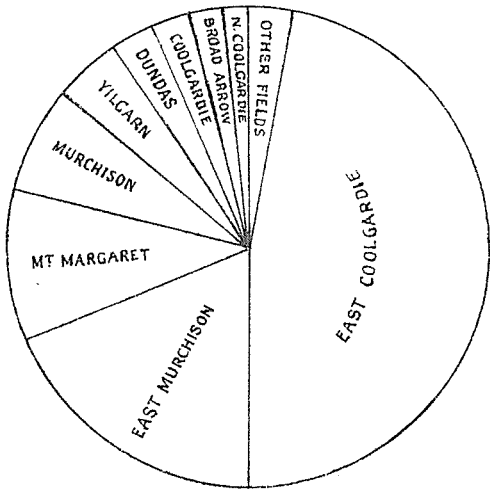


Fig. 2 Gold produced from various Goldfields as given by the Export and Mint Returns.

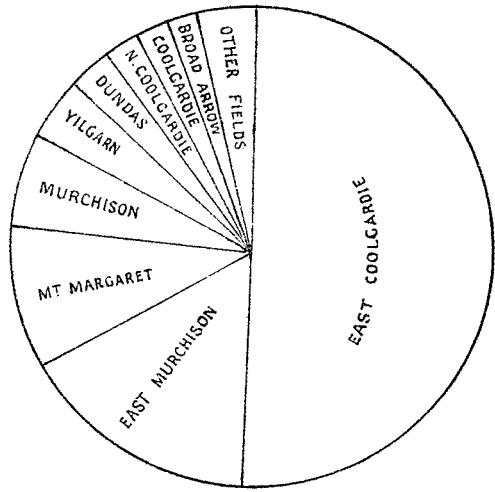


Fig. 3 Value of Gold and other Minerals.

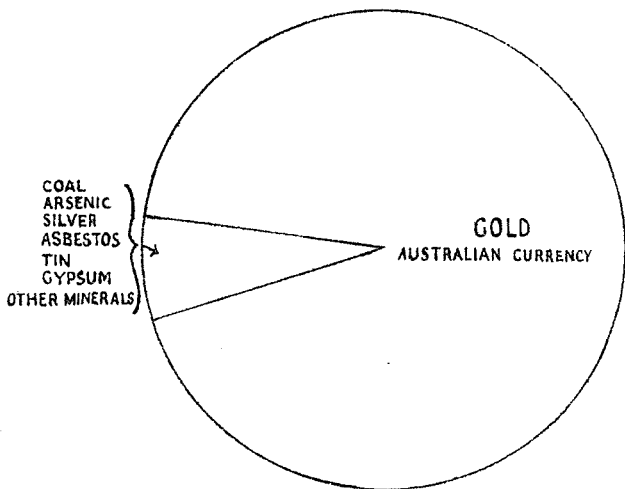


Fig. 4 Value of Minerals other than Gold.

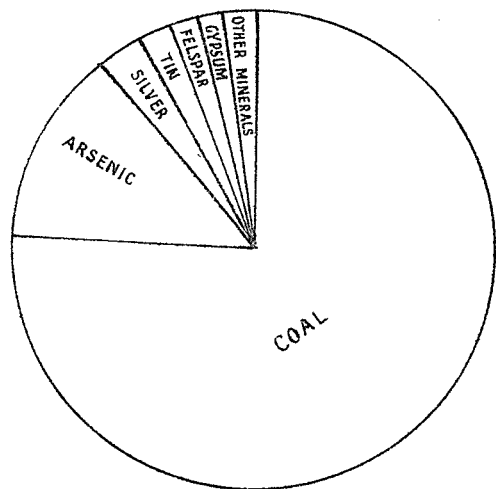


Fig. 5 Areas of Land leased for Goldmining on various Goldfields.

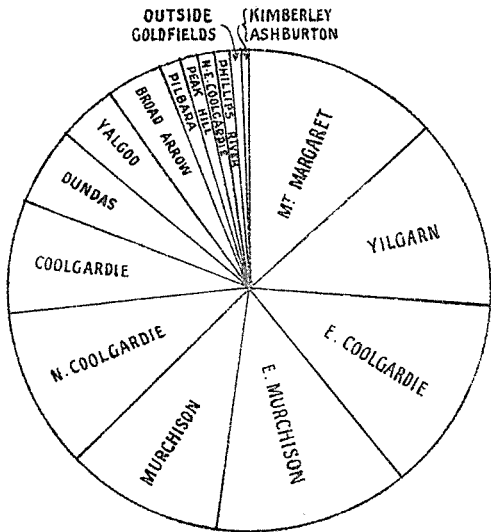
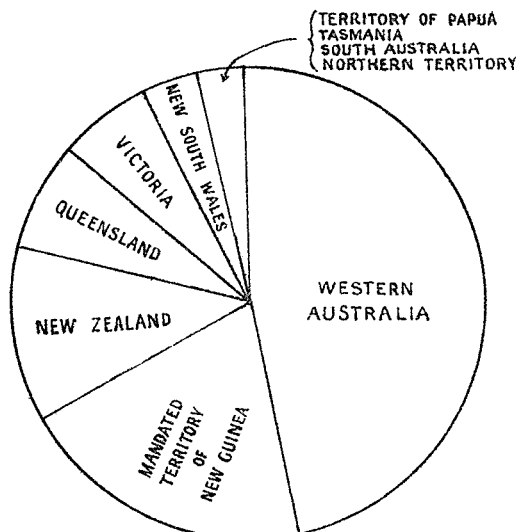
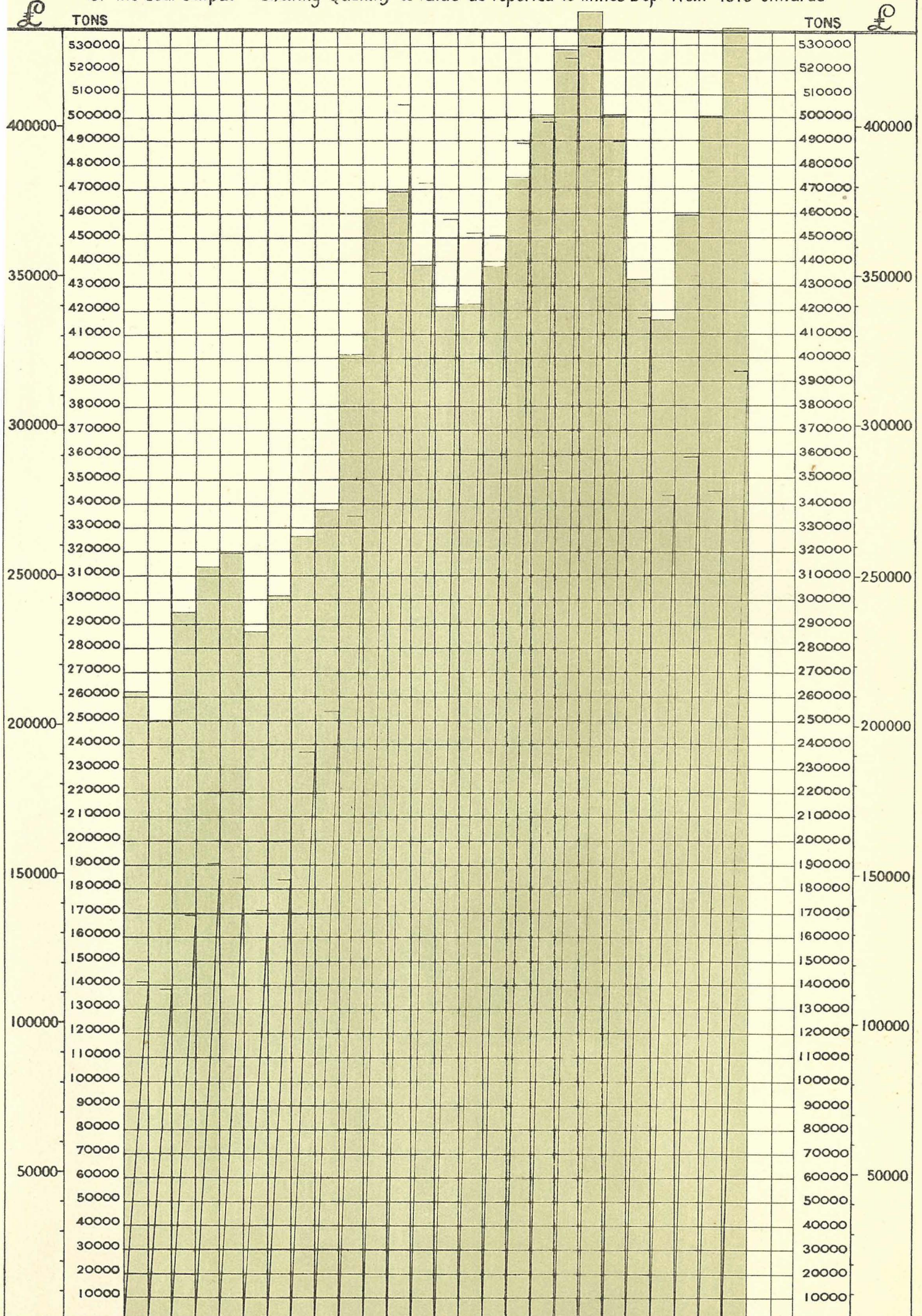


Fig. 6 Output of Gold in the States of Australia and the Dominion of New Zealand.



D I A G R A M

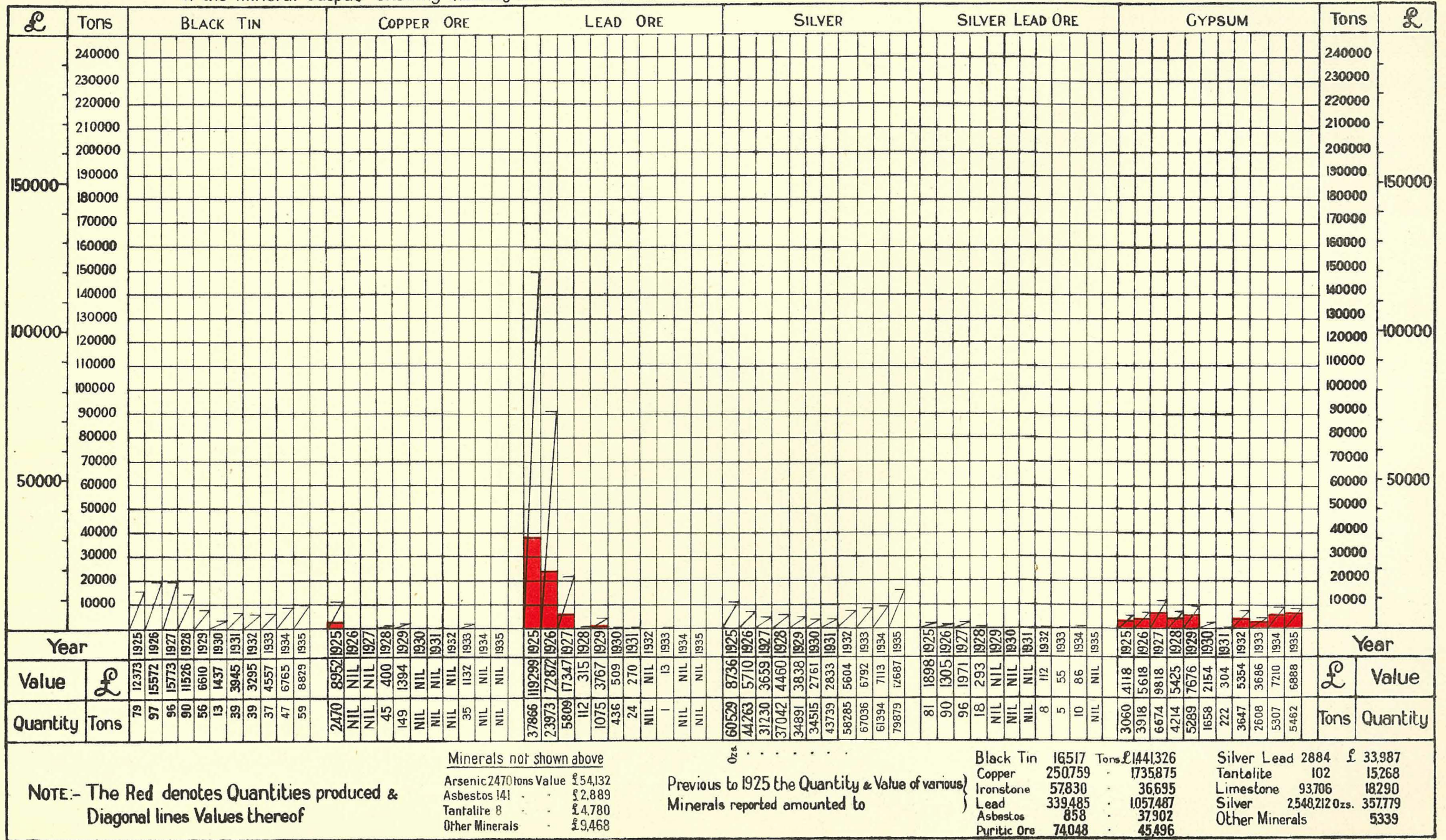
Of the Coal Output - Shewing Quantity & Value as reported to Mines Dep^t from 1910 onwards



Year		1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	Year	
Value	£	113699	111154	135857	153614	148684	137589	147823	191822	204319	270355	350346	407117	381555	368949	363203	394400	407967	420145	426706	394758	336178	270630	288806	278704	318013			£	Value	
Quantity	Tons	262166	249890	295079	313818	319210	286666	301526	326550	337039	401713	462021	468817	438443	420714	421864	437461	474819	501505	528420	544719	501425	432400	415719	458399	500343	537188			Tons	Quantity

D I A G R A M

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



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

Minerals not shown above
 Arsenic 2470 tons Value £54,132
 Asbestos 141 - - £2,889
 Tantalite 8 - - £4,780
 Other Minerals - - £9,468

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

Black Tin	16517	Tons	£1441,326	Silver Lead	2884	£ 33,987
Copper	250759	-	1735875	Tantalite	102	15268
Ironstone	57830	-	36695	Limestone	93,706	18290
Lead	339,485	-	1,057,487	Silver	2,548,212	0zs. 357,779
Asbestos	858	-	37,902	Other Minerals		5339
Pyritic Ore	74,048	-	45,496			

PART IV.—MEN EMPLOYED.

TABLE 10.

Average number of Men engaged in Mining during 1934 and 1935.

Goldfield.	District.	Reef or Lode.		Alluvial.		Total.	
		1934.	1935.	1934.	1935.	1934.	1935.
1. Kimberley ... ..	...	...	13	6	5	6	18
2. Pilbara	{ Marble Bar	189	212	13	5	202	217
	{ Nullagine	21	67	3	...	24	67
3. Ashburton ... ..	...	...	3	4	3	4	6
4. Gascoyne ... ..	...	...	4	4	2	6	6
5. Peak Hill ... ..	...	63	61	...	...	63	61
6. East Murchison	{ Lawlers	88	151	...	...	88	151
	{ Wiluna	1,222	1,441	...	...	1,222	1,441
	{ Black Range	341	321	...	...	341	321
	{ Cue	487	535	...	38	487	573
7. Murchison	{ Meekatharra	355	430	...	...	355	430
	{ Day Dawn	188	147	...	10	188	157
	{ Mt. Magnet	469	457	...	...	469	457
8. Yalgoo ... ..	...	475	525	...	...	475	525
9. Mt. Margaret	{ Mt. Morgans	221	274	...	...	221	274
	{ Mt. Malcolm	513	484	15	13	528	497
	{ Mt. Margaret	370	604	...	...	370	604
	{ Menzies	315	409	10	14	325	423
10. North Coolgardie	{ Ularring	166	164	6	5	172	169
	{ Niagara	101	133	11	20	112	153
	{ Yerilla	197	226	6	4	203	230
11. Broad Arrow ... ..	...	656	718	26	24	682	742
12. North-East Coolgardie	{ Kanowna	140	146	10	9	150	155
	{ Kurnalpi	61	58	5	5	66	63
13. East Coolgardie	{ East Coolgardie	3,330	3,368	52	51	3,382	3,419
	{ Bulong	131	136	6	10	137	146
14. Coolgardie	{ Coolgardie	812	1,062	73	115	885	1,177
	{ Kunanalling	227	361	16	22	243	383
15. Yilgarn ... ..	...	574	915	18	53	592	968
16. Dundas ... ..	...	354	621	8	23	362	644
17. Phillips River ... ..	...	82	164	...	...	82	164
State generally ... ..	...	81	67	...	...	81	67
Total—Gold Mining		12,233	14,277	290	431	12,523	14,708
MINERALS OTHER THAN GOLD.							
Alunite	State generally	1	...	...	...	1	...
Asbestos	{ Pilbara	8	7	...	...	8	7
	{ West Pilbara	9	7	...	...	9	7
Arsenic	Wiluna	35	27	...	...	35	27
Coal	Collie	624	689	...	...	624	689
Glauconite	Gingin	3	3	...	...	3	3
Gypsum	{ Yilgarn	7	4	...	...	7	4
	{ State generally	12	15	...	...	12	15
Felspar	Coolgardie	2	9	...	...	2	9
Lead	Northampton	4	10	...	...	4	10
Ochre	Carbarup	3	...	...	...	3	...
Pottery Clay	Goomalling	3	...	...	...	3	...
Tin	{ Greenbushes	65	50	...	...	65	50
	{ Pilbara ... ..	...	...	8	8	8	8
Tantalite	Pilbara	3	17	...	3	3	20
		13,012	15,115	298	442	13,310	15,557

PART V.—ACCIDENTS.

TABLE No. 11.
MEN EMPLOYED IN MINES KILLED AND INJURED IN MINING ACCIDENTS DURING
1934 AND 1935.

A.—According to Locality of Accident.

Goldfield.	Killed.		Injured.		Total Killed and Injured.	
	1934.	1935.	1934.	1935.	1934.	1935.
1. Kimberley ... ..	...	...	...	...	...	...
2. West Kimberley ... ..	...	...	...	...	...	...
3. Pilbara ... ..	...	...	...	...	...	...
4. West Pilbara ... ..	...	...	...	...	...	...
5. Ashburton ... ..	...	...	...	...	...	...
6. Gascoyne ... ..	...	...	...	...	...	...
7. Peak Hill ... ..	...	...	...	...	...	...
8. East Murchison	5	4	128	111	133	115
9. Murchison	5	...	25	22	30	22
10. Yalgoo ... ..	...	...	1	7	1	7
11. Mt. Margaret	6	4	52	68	58	72
12. North Coolgardie ... ..	...	...	1	13	1	13
13. North-East Coolgardie ... ..	...	1	1	3	1	4
14. Broad Arrow ... ..	...	1	1	...	1	1
15. East Coolgardie	13	12	477	428	490	440
16. Coolgardie ... ..	...	3	2	4	2	7
17. Yilgarn ... ..	...	2	1	8	1	10
18. Dundas ... ..	...	1	3	2	3	3
19. Phillips River	1	...	...	...	1	...
MINING DISTRICTS—						
Northampton ... ..	...	...	...	...	...	...
Greenbushes ... ..	...	...	...	...	...	...
Collie ... ..	...	2	236	287	236	289
Swan	3	...	2	51	5	51
Total	33	30	930	1,004	963	1,034

From the above table it will be seen that the total number of fatal accidents for the year 1935 is 30, as against 33 in the preceding year. The number injured shows an increase of 74. In the report of the State Mining Engineer, published as Division II. of this Report, these accidents are classified according to the causes.

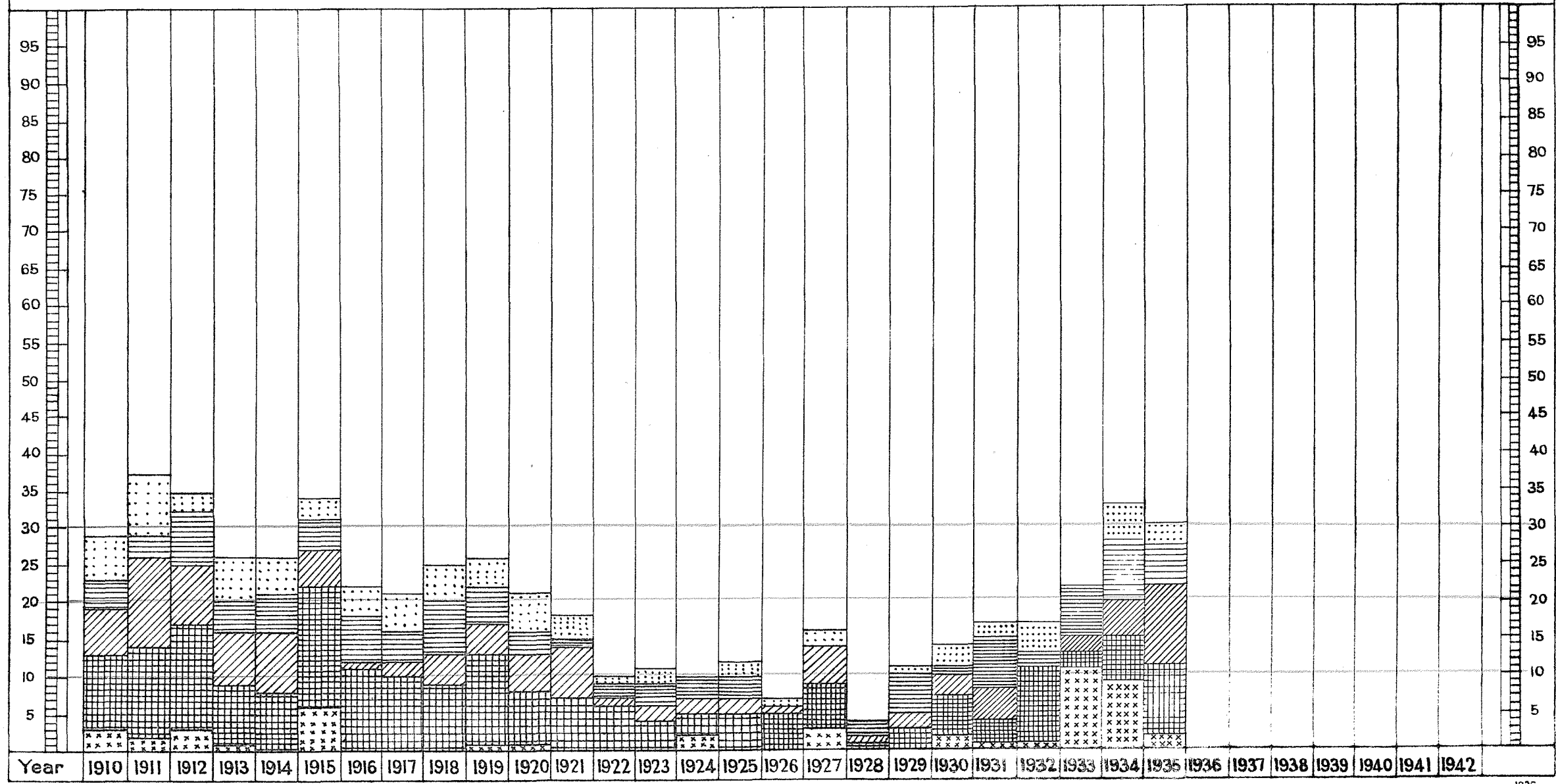
B.—According to Causes of Accidents.

	1934.		1935.		Comparison with 1934.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1. Explosives	9*	16*	2	17	— 7	+ 1
2. Falls of Ground	6	65	9	65	+ 3	...
3. In Shafts	5	25	11	30	+ 6	+ 5
4. Miscellaneous Underground	8	656	5	683	— 3	+ 27
5. Surface	5	168	3	209†	— 2	+ 41
	33	930	30	1,004	— 3	+ 74

* Includes 3 fatal and 2 serious accidents at a stone quarry. † Includes 51 serious accidents at stone quarries.

Twenty-eight fatal accidents occurred at gold mines and two at coal mines. The death rate per 1,000 men employed at gold mines was 1.96 as against 2.45 in 1934.

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



EXPLOSIONS
 FALLS OF GROUND
 IN SHAFTS
 MISCELLANEOUS UNDERGROUND
 ON SURFACE INCLUDING MACHINERY

PART VI.—STATE AID TO MINING.

The number of State Batteries existing at the end of the year was 25, with four leased. From inception to the end of 1935 gold and tin to the value of £7,771,686 15s. 4d. have been recovered from State plants. 1,964,402.44 tons of auriferous ore have been treated and have produced £6,065,290 1s. 0d. by amalgamation; £1,337,371 4s. 8d. by cyanidation; £265,266 2s. 3d. by slimes; £9,353 7s. 5d. from residues, and \$1,786 tons of ore produced tin to the value of £93,834, and in addition £572 were recovered from residues.

During the year gold ore treated was 108,360 tons for 57,683.10 ozs. of bullion by amalgamation, producing 54,771 tons of payable tailings yielding 15,634.35 ozs. and 37,311 tons of unpayable tailings, yielding 2,703.6 ozs., making a total of 92,082 tons for 18,337.95 ozs.

The working expenditure for all plants was £110,858 11s. 1d. and the Revenue £120,770 5s. 6d., which shows a profit of £9,911 14s. 5d. on the year's operations.

The capital expenditure since inception of the scheme has been £455,082 2s. 11d.; £363,100 18s. 9d. from General Loan Fund, and £91,981 4s. 2d. from Consolidated Revenue.

The cost of administration for the year was £7,154 18s. 0d. as against £4,887 10s. 2d. for the year 1934.

The working expenditure from inception to the end of the year exceeds the Revenue by £118,721 14s. 2d.

GEOLOGICAL SURVEY.

The work of the Geological Survey for the twelve months under review consisted of the following investigations and reports:—

Investigation of faulting problems at the Co-operative Colliery, Collie.

Yellowdine gold find (Palmer's Find).

Prospecting operations at Donnybrook.

Examination of the Ora Banda Amalgamated Mine at Grant's Patch (in progress).

Mullewa gold find.

Domestic and Battery water supplies at Spargoville, Logan's Find, and Cave Rocks, Coolgardie Goldfield.

Domestic and Battery water supplies at Edward's Find, Yilgarn Goldfield.

Abbott's Mining Centre, Murchison Goldfield.

Water supply for the Tuckanarra Battery, Murchison Goldfield.

Prospecting Area 1855N near Meekatharra, Murchison Goldfield.

Prospecting activities at "White Horse" near Meekatharra, Murchison Goldfield.

Burgess' Find, Avon district.

Progress report on the geology of portion of the Yilgarn Goldfield.

Progress report on groups of mines examined during the survey of portion of the Yilgarn Goldfield, including the following groups:—Jaccoletti, Glendower, Lenneburg's, Burbidge, Marvel Loch, Xantippe, Donovan's Find and Edward's Find.

Work of a non-mining nature included investigations of pastoral and agricultural water supplies, the investigation of building stone and forestry problems, and the examination of a dam-site for the Commonwealth Government.

The Western Australian section of the field staff of the Aerial, Geological and Geophysical Survey of Northern Australia was employed in the Pilbara district throughout the year, and completed detailed geological surveys and mine examinations at the following mining centres:—Bamboo Creek, Marble Bar, Nullagine, Blue Spec, McPhee's Patch, Talga Talga, North Pole, Lalla Rookh.

In addition, all field officers of the State Survey and of the Northern Australia Survey at various times made inspections and tendered verbal advice to prospectors in the districts in which they were working.

Assistance under "Mining Development Act, 1902."

The following statement shows the sum advanced during the year 1935, under "The Mining Development Act, 1902":—

	£	s.	d.
1. Advanced in aid of Mining Work and Equipment of Mines with Machinery	1,794	7	3
2. Subsidies on Stone Crushed for the Public	187	12	6
3. Providing Means of Transport, Equipment and Sustenance to Prospectors	15,267	11	9
	<u>£17,249</u>	<u>11</u>	<u>6</u>

Other Assistance granted from the Vote during the year on various matters totalled 27,541 14 11

The Subsidies paid on stone crushed for the Public amounted to 187 12 6

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 1,423 tons.

The Receipts under the Mining Development Act, exclusive of Interest payments, amounted to 18,212 1 3 and included—

	£	s.	d.
Refunds of Advances ..	3,732	7	5
Sales of Securities ..	1,593	12	6
Miscellaneous Refunds ..	4,767	9	11
Amount transferred from Other Ore Advances ..	8,118	11	5

£18,212 1 3

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 3,969, as against 3,878 total for the preceding year, showing an increase after all adjustments of 91 boilers.

Of the total 3,969 useful boilers, 2,101 were out of use at the end of the year; 1,815 thorough and 44 working inspections were made, and 1,827 certificates were issued.

Permanent condemnations totalled 15, and temporary condemnations 31. There were no conversions. Two boilers were transferred beyond the jurisdiction of the Act, and one was reinstated.

The total number of machinery groups registered was 11,435, against 10,754 for previous year, showing an increase of 721.

Inspections made total 8,615 and 3,866 certificates were granted.

Seven hundred and forty-eight applications for engine-drivers and boiler attendants' certificates were received and dealt with, and 646 certificates, all classes, were granted as follows:—

Winding Competency (including certificates issued under Regulation 40 and Section 60)	42
---	----

First Class Competency (including certificates issued under Regulations 40 and 45, and Sections 60 and 63)	26
Second Class Competency (including certificates issued under Regulation 40 and Section 60)	64
Third Class Competency (including certificates issued under Regulation 45 and Section 63)	135
Locomotive Competency	10
Traction Competency	5
Internal Combustion Competency	121
Crane and Hoist Competency	14
Boiler Attendants' Competency	207
Interim	5
Copies	6
Transfers	11
	646

The total revenue from all sources during the year was £7,824 6s. 8d., as against £6,766 13s. 8d. for the previous year, showing an increase of £1,057 13s. 0d.

The total expenditure for the year was £5,753 1s. 8d., as against £4,855 4s. 4d. for the previous year, showing an increase of £897 17s. 4d.

PART VIII.—SCHOOL OF MINES.

In this, the 32nd year of the School's existence, there was a large increase in enrolments on the previous year which had been the best in the School's records. The usual falling off occurred, but was partly compensated by late enrolments in the second and third terms. The attendances at classes have been generally satisfactory. There has not been any difficulty in finding good positions for students when they are sufficiently trained, the demand in the mining industry for qualified men still exceeding the supply. Many old students are holding important executive positions with various mining companies.

In the Metallurgical Laboratory 42 investigations were completed and reports issued.

The demand for research of this kind shows no sign of diminishing, and the excellence of the work done is exemplified by the number of treatment plants being erected on lines suggested by the staff of the Laboratory.

The number of assays and chemical determinations carried out were:—

Assays for gold, 1,444; chemical determinations, 380; a total of 1,824.

The assistance offered to prospectors was again freely used, and the number of free assays and determinations was:—

Assays for gold	1,524
Assays for other metals	13
Mineral determinations	160
	1,697

Many requests for assistance and advice were received from prospectors all over the State. The advice tendered comprised information on all branches of mining. Every effort is made by the staff, particularly the Lecturer in Geology, to give the most complete answer to inquiries, enabling many prospectors, battery owners and cyanide operators to carry out their operations in a more efficient and economical manner.

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, 1936.

DIVISION II.

Report of the State Mining Engineer for the Year 1935.

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 work of this Branch of the Mines Department for the year 1935.

STAFF.

There was no alteration in the staff as far as the District Inspectors of Mines were concerned. Inspector Rockett returned from six months' Long Service leave on 7th June and again took up his duties at Cue. Inspector Veñan, who relieved him during his absence, was then transferred to Kalgoorlie. Senior Inspector Phoenix commenced three months long service leave on 1st December, and will return to duty on 2nd March, 1936.

Mr. R. J. Wallis was appointed on 22nd July as Workmen's Inspector of Mines at Kalgoorlie to fill the position which had previously been held by the late Mr. L. C. Darcey.

ACCIDENTS.

During 1935, 30 fatal and 1,004 serious mining accidents were reported to this office (including 2 fatal and 338 serious accidents from coal mines and

quarries), compared with 33 fatal and 930 serious in 1934 (including 3 fatal and 238 serious accidents from coal mines and quarries). These figures show a decrease of 3 fatal accidents. They show an increase of 74 serious accidents; of these 51 were from quarries from which only two accidents were reported for 1934.

Gold mining accidents amounted to 28 fatal as compared with 30 in 1934, a decrease of 2, and serious accidents 666 as compared with 692 in 1934, a decrease of 26. During the same period the men engaged in gold mining increased from 12,523 to 14,708.

There was an increase in the number of serious accidents in coal mines from 236 to 287, the number of men employed having increased from 624 to 689.

Table 11, showing the locality and causes of fatal and serious accidents is forwarded herewith for inclusion in your annual report, together with a diagram of 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:—

—	1931.	1932.	1933.	1934.	1935.
Fatal accidents to men engaged in mining (exclusive of quarries)	17	16	22	30	30
Total number of men engaged in mining (average) ...	7,147	8,695	10,690	13,310	15,557
Accident death rate per 1,000 men	2.38	1.96	2.06	2.25	1.93
Fatal Accidents at Quarries ... ..	...	1	.	3	...

FATAL ACCIDENTS.

Brief particulars of the fatal accidents which occurred during the year are given hereunder:—

There were two fatal explosive accidents.

A miner was firing out a winze and lost his life as the result of a premature explosion. Having lit the fuses, he was being raised in a bucket when an explosion occurred which killed him, and also injured the miner on the hoist and a trucker who happened to be looking down the winze. Electric firing was recommended by the jury. We recommend the cartridge system.

Two miners were firing out seven sand blasts, and an explosion occurred before they got away. Both of the miners were injured and one of them subse-

quently died in the hospital. As a result of this fatality, instructions were issued by the Inspector of Mines that in all future cases where more than four pops or sand blasts were to be fired at one time, six feet lengths of fuse were to be used. The fuses used were three feet only.

Falls of Ground.

Nine fatal accidents occurred as the result of falls of ground; brief details of each being as set out hereunder:—

A shoveller was barrowing dirt from the face of a drive when a V-shaped piece of ground fell away from the back of the drive on top of him. It was stated that this ground had been regularly sounded and that it appeared safe.

A coal miner was standing on a heap of coal trimming the face when a piece came away and struck him on the chest causing him to fall backwards. His head struck another piece of coal and his neck was found to have been broken.

Two men were barring down loose pieces of ground after a fall in a stope in order to make the place safe. Unexpectedly, however, a second fall of about 20 tons occurred and killed them both instantaneously. When the place was inspected by an inspector, there did not seem any probability of another fall, but as a precautionary measure it was decided to suspend operations in this stope for a month and make another inspection before permitting work to proceed.

A prospector was at work in a stope when some ground came away unexpectedly and killed him. His mate stated that the stope was only about 5 feet above the mullock and that deceased thought it safe.

Two men were at work in a costean which was about nine feet in depth, when some ground on one side of it fell away and buried them.

A machine miner was proceeding along a level to his work when a fall of several tons occurred, one piece striking him on the head, and killing him. The timbering of this drive was in progress and the timberman had tried the ground on the previous day, and considered it safe.

A man was barring down ground in a shrink stope and was fatally injured by a fall of ground from the eastern wall. It appears that the rill of broken ore had hung up and had to be fired. When this ore came away it apparently loosened the ground at the foot of the rill. The deceased must have noticed that it was loose and attempted to bar it down.

In Shafts.

Eleven men lost their lives in shafts, brief details being as follows:—

A man working at a depth of 150 feet complained of feeling ill and was advised to go to the surface. When within a few feet of the surface he apparently collapsed with the result that he fell off the ladder and was killed.

Another miner died from injuries received in a very similar manner. He was climbing a shaft which was only 60 feet deep. He stated that he had a lamp in one hand and missed the rung of a ladder with the other, and fell back into the shaft.

A remarkable double fatality occurred when seven men, including the two who lost their lives, were being pulled to the surface. Although the cage was provided with lattice doors reaching to within six inches of the floor at three points, one man's foot appeared to have caught in the shaft, as he was dragged under this door and was found at the bottom of the shaft. Another man was partly dragged under the door and fatally injured. It was suggested that the first man had caught him by the legs as he felt himself being dragged out of the cage.

In view of the accident, arrangements were made to reduce the already small clearance between the doors and the floor of the cage.

A platman was killed in a shaft while proceeding from one level to another with diamond drillers and their gear. No trouble was experienced in the top compartment of the cage, but in the lower compartment the gear appeared to have been insufficiently fastened and to have moved about, caught in the shaft and caused the deceased to be drawn between the cage and shaft, and eventually to fall down the shaft.

The accident was the result of a breach of General Rule 21, Section 32 of the Mines Regulation Act, but as the deceased was in charge of the cage a prosecution of the other men was not proceeded with.

A sampler at No. 5 Level in a mine was taking his gear out of a truck in a cage when it moved off unexpectedly and as a result the deceased was squeezed between the truck and the shaft, receiving fatal injuries. The gear had actually been sent from the surface to the No. 4 Level, but owing to the practice of emptying the water tank before sending it to No. 4 Level, it was temporarily at No. 5 Level while the water was being emptied. It was not good practice to have the cage geared so that it was at the No. 5 Level when the tank was being emptied, but this did not seem to involve any danger as no regular work was in progress at the No. 5 Level.

Two men were driving a level at a depth of 125 feet and had driven about 35 feet. On arriving at the face of the drive fumes were noticeable and the two men attempted to climb the ladders. One man fell off the ladder and never recovered consciousness, while the other was rescued at considerable risk by fellow workers, who also were gassed to some extent. He was found hanging on to the ladder in a semi-conscious state. His rescuers were awarded silver medals by the Royal Humane Society for their bravery. The unfortunate deceased man, who was also the manager, appeared to have been mainly to blame for not seeing that the fracture fumes were blown out of the drive before returning to work.

A man who was employed on the surface as a fireman was found in a dying condition lying across the riding platform of the bailing tank when it reached the 100ft. level. His head was crushed and it was suggested that he was probably looking down the shaft when the bailing tank struck him.

A man was standing on a bailing tank when the balance weight of a knocker line became detached, fell down the shaft and struck him. He was so seriously injured that he died on the way to the hospital. In view of the accident, inspectors were instructed to give particular attention to all other balance weights so as to eliminate the possibility of any similar occurrence.

A prospector was found drowned in an old abandoned shaft. No one saw him go down. Possibly he ventured down to do some prospecting.

A miner was at work in a shaft and while a kibble of dirt was being raised he was struck on the back of the head, with fatal results. It was suggested that the kibble caught the timber when passing the penthouse, causing a stone to fall out. The Inspector ordered a monkey to be used during the next lift. The mate of deceased did not consider the place unsafe.

Miscellaneous Underground.

Five men were killed by miscellaneous accidents underground, as follows:—

A miner was being pulled up a winze, 150ft. deep, by means of a hoist and had reached a point 50 feet from the level when it is stated that the clutch slipped and the kibble ran away. When it had dropped 80 feet it stopped suddenly. Deceased was thrown out of the kibble and died from a fractured and lacerated skull. This accident appears to have been due to faulty adjustment of the clutch. The jury added a rider that adjustments to hoists should be more strict and overhauls in workshops more frequent. Inspectors were instructed to see that the jury's recommendation was carried out.

A man was endeavouring to push a truck from the main to a side line. Apparently it jammed and a train backing along the level struck his truck and the deceased, who had stepped aside, was squeezed between his truck and the wall of the drive. He received fatal injuries. Noise prevented the driver from hearing the guard's whistle.

A miner was coming down a manway which was a few feet only above the level. He apparently missed his footing and fell, catching his foot as he did so. He was found hanging to the ladder, head downwards. The Inspector found no fault with the ladder.

A miner was killed in an underhand stope as the result of a ladder failing to hold his weight. It was found that the ladder was faulty inasmuch as it had

no bolt at one end. Apparently it had been hung by this end and the rung had pulled out. The manager was prosecuted for permitting this unsafe practice and fined £5. It was intended to prosecute the other two men concerned, but they could not be found.

A coal miner was on his way to the surface when he received fatal injuries by being kicked by a horse.

Surface.

There were three fatal surface accidents during the year.

A millman caught his arm between a belt conveyor and a pulley wheel and died three weeks afterwards in the hospital. It was suggested that his sleeve may have caught in one of the steel lacing teeth.

One of the crossbars of a conveyor required a new nut on it and as a pipe fitter raised the conveyor by means of a pinch bar, the mill repair foreman was putting on a new nut when the bar slipped, and the conveyor dropped, crushing the index finger of the foreman's right hand. He developed septicaemia and died nineteen days later.

A man working in a trench was lifting a stone when he slipped and injured his side. He developed pleurisy and pneumonia and died eight days later.

The following table shows all the fatal and serious accidents reported to this office during 1935, and are classified according to the gold or mineral field in which they occurred. The causes of accidents are also shown:—

	Explosives.		Falls of Ground.		In Shafts.		Miscellaneous Under-ground.		Surface.		Total.	
	Fatal.	Seri-ous.	Fatal.	Seri-ous.	Fatal.	Seri-ous.	Fatal.	Seri-ous.	Fatal.	Seri-ous.	Fatal.	Seri-ous.
1. East Coolgardie	1	7	1	7	5	9	2	337	3	68	12	428
2. Mt. Margaret	4	2	...	5	...	41	...	20	4	68
3. Coolgardie	3	2	1	1	...	...	...	...	...	3	4
4. North Coolgardie	4	...	8	...	1	...	13
5. North-East Coolgardie	1	1	...	2	1	3
6. Broad Arrow	1	...	...	...	...	...	1	...
7. Dundas	1	1	...	...	...	...	...	1	1	2
8. Yilgarn	2	2	...	2	...	4	2	8
9. Murchison	2	...	5	...	2	...	8	...	5	...	22
10. East Murchison	1	2	...	6	2	8	1	67	...	28	4	111
11. Peak Hill
12. Yalgoo	3	...	...	...	...	...	3	...	1	...	7
13. Northampton
14. Greenbushes
15. Swan	51	...	51
16. Phillips River
17. Collie	1	43	...	...	1	216	...	28	2	287
18. Pilbara
Totals for 1935	2	17	9	65	11	30	5	683	3	209	30	1,004
Totals for 1934	*9	*16	6	65	5	25	8	656	5	168	33	930

* Including 3 fatal and 2 serious accidents which occurred at a stone quarry.

SERIOUS ACCIDENTS.

In a large number of the serious accidents, the injuries were really very slight but as they involved the absence from work of 14 days, they were serious accidents as defined by the Act.

In the future, it is intended to require Under-ground Supervisors to obtain Certificates of Competency before they will be allowed to hold such positions. This, it is hoped, will tend to reduce accidents.

It is also intended to enforce the cartridge system of firing or its equivalent and it is confidently anticipated that by doing so, a number of accidents due to premature explosions will be eliminated.

WINDING MACHINERY ACCIDENTS.

Fourteen accidents to winding machinery, which included three skip derailments, eight overwinds, and three miscellaneous accidents were reported during the year.

Three skip derailments occurred in the early part of the year, two of these doing considerable damage to the shaft. A detailed examination was made by the Inspector of Mines, and after consultation with the management, it was decided to cut down the rate of haulage and instal devices to control the speed. No further derailments have taken place since these precautions were taken.

All overwinds were also fully reported on by the Inspectors of Machinery and considered by the Engine Drivers' Board.

Miscellaneous.—The fracture of a crank shaft was probably due to the excessive strain placed on the engine by the derailments in the early part of the year.

In another instance, the top of head frame collapsed. Water was being pulled from the 1,000ft. level when the driver noticed the rope slacken, and he was about to pull up when the sheaves collapsed.

A rope on a balance shaft broke. It was known that the rope was faulty and the management's notice was drawn to the lack of attention over the matter.

ADMINISTRATION.

Amendments of Acts.

Mines Regulation Act, 1906—Regulation 4.—Addition of General Rule 51—First Aid Outfit. (Gazetted 17th May, 1935.)

Regulation 4, General Rule 1.—Cancellation of Gazette Notice dated 17th May, 1932, and substitution of amended General Rule 1—Ventilation of Mines. (Gazetted 17th May, 1935.)

Section 32.—Variation of Paragraphs (g) and (h) of General Rule (3), so far as relates only to mines using rock drills to bore holes for blasting underground. (Gazetted 8th March, 1935.)

Regulation 4.—Amendments of General Rules 24; 38 (2), (3), (4), and (6); 47 and 49. (Gazetted 8th March, 1935.)

Regulation 17a.—Additional regulation—Certificate for Underground Supervisors. (Gazetted 8th March, 1935.)

Regulation 9.—Additional paragraph at the end thereof—Knowledge of Signals. (Gazetted 12th July, 1935.)

Regulation 7.—Amendments of Clauses (2), (4) and (5); also Forms 2 and 6. (Gazetted 4th October, 1935.)

Regulation 2a.—Additional regulation—Lights. (Gazetted 25th October, 1935.)

Regulation 17a.—Was disallowed on 22nd October and new Regulation 17a (with amendment) gazetted on 29th November, 1935—Certificates for Underground Supervisors.

Regulations under "The Mines Regulation Act, 1906," reprinted with amendments in lieu of the regulations heretofore in force. (Gazetted 12th July, 1935.)

Prosecutions.

During the year, eight prosecutions under "The Mines Regulation Act, 1906," were undertaken, six of which were for breaches of Regulation 7,

In four of these cases, managers were prosecuted for employing men without the prescribed medical certificate showing they were free from the diseases specified in the above Regulation; in one case a manager was prosecuted for employing men on expired interim certificates, and in the other case a miner was prosecuted for working in a mine without the necessary medical certificate. In all cases, fines were inflicted.

Under Section 57, two skipmen were fined for leaving a safety pin out of a chute door which was struck by a skip, causing injury to one of the skipmen.

Under Section 32, a manager was prosecuted for failing to circulate an adequate supply of pure air into the underground workings, but the case was dismissed.

Exemptions.

One hundred and sixty-one certificates were issued in accordance with the provisions of Section 31 (4) for exemption from the provisions of Section 31, Sub-section 1 (b) of "The Mines Regulation Act, 1906."

Sunday Labour.

Four permits to employ men on Sundays were granted during the year.

Permission was granted for fifteen men to work on Sundays for three months, to carry out the stripping of the main shaft in order to meet haulage requirements by the time the new plant was completed.

In two instances, Sunday labour was permitted for the sinking of the main shaft to keep down the water level.

Sunday labour was necessary in order to raise complex ore for experimental treatment without interfering with the normal working of the mine.

LOANS AND SUBSIDIES.

The following monetary assistance was given to the mining industry:—

	£	s.	d.
Advances towards development work and equipment of mines	1,794	7	3
Providing transport and general assistance to prospectors	15,267	11	9
Cartage subsidies—Paid to Prospectors on ore treated at State Batteries	20,321	16	11
Subsidies paid to privately-owned batteries	187	12	6
Miscellaneous Expenditure	7,219	18	0
	£44,791	6	5

The total expenditure was £44,791 6s. 5d., compared with £53,307 8s. 11d. during 1934, and £50,807 6s. 4d. during 1933. (Appendix No. 1.)

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

GOLD MINING.

The steady improvement in the gold mining industry since 1929 has been maintained. Despite the fact that industrial trouble caused a complete suspension of operations on all the big mines from the 6th January to the 18th February, more ore was

treated and more gold won than in the previous year, and gold reached a new high level price, averaging 175.71 shillings per ton in value.

The following figures strikingly demonstrate the improved condition of the industry:—

Year.	Ore Treated.	Average Number of men employed.	Total Gold Yield.	Value of Gold Australian Currency.	Average value per ton.		Value of Gold per oz. Australian Currency.
					Dwts.	Shillings, Australian Currency.	
	tons.		Fine ozs.	£			shillings.
1929 ...	628,400	4,108	372,064	1,580,426	11.84	50.30	84.96
1930 ...	645,344	4,452	419,767	1,874,484	13.01	58.09	89.31
1931 ...	982,163	6,344	518,045	3,042,019	10.55	61.95	117.44
1932 ...	1,327,021	7,983	599,421	4,358,989	9.03	65.69	145.44
1933 ...	1,588,979	10,165	636,928	4,884,112	8.02	61.47	153.36
1934 ...	1,772,353	12,523	639,871	5,461,004	7.22	61.62	170.69
1935 ...	1,909,832	14,708	646,150	5,676,681	6.78	59.45	175.71

Note.—These figures comprise those reported direct to the Department by producers and vary slightly from the official figures of annual production which comprise Royal Mint figures plus figures of gold exported.

In previous years the value of the gold lodged at the Perth branch of the Royal Mint was taken for computing the average value per ton. During the year 1935 some of the gold produced was diverted to other destinations and the average value is calculated on the quantity of gold reported to the Mines Department and previous years' figures adjusted on a similar basis.

It will be observed that gold began to increase in value above its normal price in 1930 and has continued to do so each year since.

The ore treated has increased from 628,400 tons in 1929 to 1,909,832 tons in 1935, and the value of the gold won from £1,580,426 to £5,676,681 in Australian currency, and the number of men employed from 4,108 to 14,708.

Last year I drew attention to the fact that the gold exported from the State was of considerably higher value than that of either wool or wheat. The following figures show that this is again the case:—

Value of gold exported	£5,568,452
Value of wool exported	£4,529,182
Value of wheat exported	£2,909,812

It is pleasing to be able to report that the mines generally continue to show improved efficiency both underground and on the surface. There is not the boom that existed a year or two ago, but the industry as a whole is in an increasingly prosperous condition and is settling down on a solid basis which augurs well for the future.

VENTILATION.

There have been notable advances in ventilation during the year. The installation of forced ventilation on three large mines is proceeding and the electric fans and larger pipes for the ventilation of dead ends are being used and are a distinct improvement. Better ventilating appliances reduce operating costs. The more elaborate ones, of course, require increased care on the part of the miner to prevent damage to them. A few brief details are as follows:—

At the Lake View and Star, Ltd., as the result of extensive development work in the western leases connections have been made at depth between the

Ivanhoe, Horseshoe and Chaffers mines. In February an exhaust fan was installed at the top of the Horseshoe Main Shaft, but its effectiveness was reduced by serious leakages of air. The repair of the shaft was begun but was not completed at the end of the year. It is proposed to instal a pressure fan at the 2,600ft. level of this shaft to reduce the negative pressure and minimise leakage.

At the Great Boulder Proprietary, Ltd., the old fan at the 2,600ft. level has been replaced by a 15-inch air driven Holman fan, having a capacity of about 5,000 cubic feet per minute, which meets present requirements. The whole ventilation scheme will be reviewed when connections from the Main and Edwards Shafts to Hamilton Shaft have been made.

At the Iron Duke Mine, a return airway through the Hinchcliffe Shaft will be formed. An electric fan is being used for the main development work.

At Hannans North Mine, the current in the Main Shaft was reversed and the ventilation improved by stoppings at suitable places.

At the Lancefield (W.A.) Gold Mine, N.L., the ventilation shaft has been stripped and increased in size from 6ft. by 4ft. to 12ft. by 6ft. and an exhaust fan placed on top of the shaft. The large openings at this mine make ventilation difficult. The filling of the lower levels is contemplated, and if carried out will benefit the ventilation.

At Wiluna the ventilation has been reasonably satisfactory, but a falling off during the summer months was noticeable.

At the Norseman Gold Mines good progress has been made with level to level connections and the mine is well provided with airways. There has been some difficulty in getting a good circulation, and a fan at the south air shaft is to be installed.

The Phoenix Mine generally is well ventilated naturally and more than ordinary care is given to the forced ventilation of the development ends.

OPERATIONS OF THE PRINCIPAL MINES.

Brief details of the operations of some of the more important gold mines of the State are given hereunder:—

East Coolgardie Goldfield.

This goldfield includes Kalgoorlie, our principal gold mining centre. The big producing mines have generally increased their outputs and despite a stoppage of two months, the development footages are approximately equal to those of last year and are a long way ahead of those for the preceding years, as will be noted from the following figures:—

Year.	Shaft Sinking.	Driving.	Crosscutting.	Rising and Winzing.	Diamond Drilling.	Totals.
1932 ... ..	...	18,948	6,984	7,472	10,316	43,720
1933 ... ..	...	26,671	18,868½	9,367	15,568½	70,897
1934	589	32,533	13,448	13,687	48,480	108,737
1935	807	32,467	14,511	14,044	43,219	105,048

The Lake View and Star, Ltd.—This company, which is the largest producer in the State, had a successful year. The monthly tonnage is now 50,000 tons of ore and in addition an equal amount of residue is re-treated from the Associated residue dump. Underground developments have been generally satisfactory.

At the Chaffers Lease, the No. 4 Lode was driven on at the deepest level, 3,400 feet, for over 1,000 feet, exposing a very rich shoot of ore and long lengths of average grade ore. This development is important as a proof of the downward extension of the Kalgoorlie lodes and the maintenance of their values.

At the Hannans Star section, preparations are being made to sink an internal shaft from the No. 11 level on the Morrison Lode. This shaft will be 9 feet by 5 feet and equipped with electric haulage.

The Horseshoe main shaft is being reconditioned and when completed to the 2,600ft. level, a fan will be installed and this shaft will be the main up-cast shaft for the western group.

At the Lake View and Associated sections, developments have been very satisfactory and both sections have opened up additional ore supplies.

On the surface there has been considerable expenditure on improvements but considerable trouble still exists over the removal of fumes from the roasters due to insufficient draught in the furnace stack. The gases and dust pass through a Van Tongeren dust collector. Attention is being given to the dispersion of the sulphurous fumes. In the power section of the plant an additional power unit and compressing unit have been installed.

The Great Boulder Proprietary.—The new treatment plant ran smoothly and continuously and was noticeably free from the dust nuisance.

Large bodies of ore have been developed in the Hamilton Shaft workings and the other workings have continued to supply the usual grade and quantity of ore.

Boulder Perseverance, Limited.—This mine ran normally for the year. Developments were quite satisfactory and the development footage was approximately the same as for the previous year.

A new flotation unit treatment plant is in the course of erection. It is proposed to discontinue bromo-cyanidation and to substitute ordinary cyan-

idation followed by flotation and subsequent roasting and cyanidation of the floated concentrates. A high extraction is anticipated by this treatment, which would appear to be the best yet evolved for the treatment of Kalgoorlie ores.

The South Kalgurli Consolidated, Ltd.—This mine has continued as usual obtaining a quota of the ore treated from the Croesus Proprietary. No striking developments were reported during the year.

The North Kalgurli (1912), Ltd.—The North Kalgurli has had a good year and has developed well in all sections.

The North Kalgurli United Mines, Ltd.—This company sank the Ironsides shaft an additional 100 feet below the 410ft. level. In addition, 1,212 feet of development and 11,765 feet of diamond drilling were carried out.

Paringa Mining and Exploration Co., Ltd.—This mine has reconditioned the levels down to No. 5 level. Trial parcels amounting to 1,658 tons were crushed for an average value of 9 dwts. 14 grs. per ton. It is anticipated that in due course this mine will have a plant of its own.

Gold Mines of Kalgoorlie, Ltd.—This company has a quantity of the ground on the eastern side of the Belt including the Iron Duke, Australia East and the Oroya South. Satisfactory development results have been obtained, and the company has leased and is operating the old Associated Gold Mine's treatment plant.

The Broken Hill Proprietary.—At Hannans North G.M. the treatment plant ran continuously during the year. The shaft was sunk a further 118 feet. The 800ft. level developed satisfactorily and shaft sinking is continuing.

At the Enterprise Leases development work proceeded and the ore won was treated at the Hannans North Plant.

Hampton Plains Mines.—At Hampton Plains, the Celebration Mine has had good developments and is now being equipped with a treatment plant.

The White Hope Gold Mine is also developing satisfactorily.

Ora Banda Amalgamated.—This mine has operated a 10-head mill. The ore is very slimy and an Oliver filter is now to be installed. The mine is opening up well.

Yilgarn Goldfield.

This Goldfield has shown considerable activity, the principal operations being as follows:—

The Southern Cross United Mines, Ltd.—The old Fraser's Mine has been unwatered and the main shaft sunk from 104 feet to a depth of 341 feet. The reef, which is up to 14 feet in width, was then cut in a crosscut and is being driven upon. The reef is also being developed at the 200ft. level, and in due course the workings at Fraser's Central Mine will be accessible. Quite a large diamond drilling programme has been carried out.

The Marvel Loch Development Company.—This company has equipped its property with a modern plant capable of treating between 4,000 and 5,000 tons per month. The plant includes rolls, a tube mill, strakes, thickeners, agitators, Oliver filters, and a Merrill-Crowe precipitation plant.

Three lodes are worked on this property. The main lode has been opened up for a length of 1,800 feet. It is estimated that there are 78,000 tons of ore available above the 100ft. level. The eastern lode is about 150 feet west of the main lode. Driving and crosscutting has proved this lode to average 25 feet in width. For the most part this lode, like the others, is a soft kaolin, but harder ore is met with at the 150ft. level which it is thought will help the treatment. The western lode is 180 feet west of the main lode and is being developed at the 100ft. level.

The total ore in sight is estimated at 207,500 tons.

The Great Victoria United.—This company proposes to erect a treatment plant to treat about 6,000 tons of ore per month.

A large tonnage of ore will be obtained from a laterite deposit partially worked in the old days. This is stated to contain payable values over a length of 2,000 feet, an average width of 100 feet and a depth of perhaps 6 feet.

It is also anticipated that a large tonnage of ore will be won from the old mine.

The Yellowdine Gold Development, Ltd.—This important property is being developed at the 100ft. level, where an ore body about 40 feet in width is being driven upon, and at intervals its full width is being exposed by crosscuts.

A large tonnage of high grade ore is now proved in this mine, and a treatment plant is being proceeded with.

The Edna May Amalgamated G.M.—The unwatering of this mine is in progress. The water making is very heavy and considerable difficulty has been experienced.

The mine has been equipped with a power plant consisting of three 500 h.p. Premier engines and with two compressors each having a capacity of 1,000 cubic feet of air per minute.

A 20-head stamp battery has also been erected and will be ready to start operations as soon as the mine is unwatered. Its estimated capacity is 4,000 tons of ore per month.

Dundas Goldfield—Norseman District.

The Phoenix G.M.—A vigorous policy of development has been carried out on this mine, including about 14,000 feet of diamond drilling.

From the 600ft. level an internal underlie shaft is being sunk and is equipped with a double drum electric winder.

A large tonnage of ore is stated to have been located by diamond drill holes in an undeveloped portion of the property north of the old workings.

The Norseman Gold Mines.—The treatment plant at this mine has operated continuously during the year and the mine has pushed ahead with development. The ventilation is to be improved by the installation of an electrically driven fan having a capacity of 20,000 cubic feet per minute which will be installed at the south end of the mine.

The O.K. Mine.—A 10-head battery has been erected and is in operation on two shifts. The main shaft has been sunk to the 500ft. level.

North Coolgardie Goldfield.

The Lady Shenton Gold Mines (1934), Ltd.—At this mine, the development work included 338 feet of shaft sinking, 1,056 feet of driving and crosscutting, 480 feet of rising and winzing, and in addition 1,000 feet of diamond drilling.

Consistently good values have been reported.

The construction of a treatment plant was almost completed at the end of the year.

The Sand Queen-Gladsome Mines, Ltd.—This mine was completely unwatered by means of an air lift, Pomona pump and bailing tanks.

The main shaft and the No. 4, No. 5, and No. 6 levels have been reconditioned. The treatment plant is now being overhauled and put into running order preparatory to starting crushing operations.

The Edjudina Gold Mines.—The ore body at this mine is a big flat porphyry dyke. It is claimed that 80,000 tons of ore have been developed. A plant has been installed to treat about 3,000 tons per month.

The ore, after being crushed in jaw crushers and finely ground in ball mills, is passed over strakes, which in experimental runs have caught practically all the gold, only half pennyweight per ton remaining in the tailings.

Mount Margaret Goldfield.

The Sons of Gwalia, Ltd.—This important mine, which has a monthly output of approximately 12,000 tons had a series of mishaps during the year. As the result of the industrial strike, a skip derailment which tore out a quantity of the shaft timbering, and the fracture of the winding engine crank shaft, the mine was idle for nearly three months.

The new tube milling and classification section of the treatment plant was completed and put into commission early in the year with the result that 40 per cent. of the gold is now recovered on the strakes.

During the year the main shaft was sunk an additional 166 feet, making its total depth 4,610 feet on the underlay. The No. 28 level is being opened up by drives off winzes from the No. 27 level.

Ventilation has been greatly improved by the installation on the No. 27 level of a second fan having a capacity of 90,000 cubic feet of free air per minute.

The Lancefield (W.A.) Gold Mines, N.L.—The Lancefield Gold Mine at Beria completed the unwatering of the old workings. A modern treatment plant was erected, commenced crushing ore in May, and at the end of the year had treated 62,045 tons for a return of 19,054 ounces of fine gold valued at approximately £167,400.

Two serious falls of ground occurred, in the second of which two men engaged in barring down loose ground unfortunately were killed. This mine is worked on the pillar system and since that time the maximum distance between pillars has been reduced from 45 feet to 35 feet, thus reducing the risk of such happenings in the future.

On account of the great width of this lode it is considered impracticable to timber the drives and a rib of rock is now being left along the levels to protect shovellers and truckers. A series of drag scoops are also being installed, thus obviating the necessity for shovellers to go into the stopes.

The ventilation of this mine, which hitherto left much to be desired, has been seriously taken in hand and a fan of 100,000 cubic feet per minute capacity is on order. The No. 5 level main north drive is being advanced and preparations are being made for the sinking of the main shaft.

Cox's Find.—Cox's Find, which is probably the most important made during the year, is situated about 42 miles in a north-easterly direction from Laverton and was discovered in May by Messrs. Cox and Escreet.

During the first three weeks a crushing of 120 tons, consisting mostly of floaters, was taken out by the prospectors and gave a return of approximately 30 dwts. per ton.

The Western Mining Corporation who took an option over the property have since sunk shafts and driven on the lode for a distance of 300 feet. It had an average width of perhaps 15 feet and for the most part carried good values.

The company exercised their option in December and commenced a main underlay shaft on the foot-wall of the main ore body.

It is intended to erect a 10-head battery without delay and it is anticipated that this will soon be a producing mine.

King of Creation G.M.—On this property a large low grade ore body associated with a jasper bar has been worked on a small scale for some years past. During the year, the mine was taken over by a company and at the end of the year a dry crushing plant was almost completed, having a capacity of about 2,000 tons per month. The mine has since been acquired by the De Bernales Group.

East Murchison Goldfield.

Wiluna Gold Mines, Ltd.—This company increased its operations during the year and is now operating the Bulletin mine. Arrangements are also in progress for the treatment of the ore from the Moonlight mine.

At the Wiluna mine, the main shaft reached a depth of about 1,600 feet and was completed to 1,400 feet. On the east lode five winzes have been put down to the 1,600ft. level and driving at this depth is proceeding to connect with the main shaft.

An ore pocket to hold 5,000 tons of ore from the Moonlight mine has been sunk from whence the ore will be hoisted and treated with the Wiluna mine ore.

Some alterations have been made to the power plant which now consists of the following:—

Two 8-cylinder 800 h.p. Crossley engines.

Two 6-cylinder 600 h.p. Crossley engines.

Three 6-cylinder 600 h.p. National engines.

Nine 4-cylinder 400 h.p. Crossley engines.

A modification of the treatment plant is also in progress and when completed the cyaniding of the roasted flotation concentrate will be discontinued and this concentrate will be sintered and smelted in a blast furnace.

This new treatment will call for 170 tons of lead concentrates, which are to be won from the lead mines in the Northampton district, and in addition 130 tons of lime and about the same amount of coke each month.

The arsenic plant continued its operations during the year and produced 3,728.25 tons of arsenious oxide which has an estimated value of £67,108.

The Bulletin shaft has been sunk to over 600 feet and equipped with a head frame, electric winder, large ore hopper and change house.

Some 10,000 to 15,000 tons of antimonial gold ore from the Moonlight mine will be trammed each month a distance of about 9,000 feet to the main shaft and tipped into the above-mentioned ore pocket.

The Moonlight Wiluna Co.—This company carried out an extensive development programme during the year. The main shaft is now down 478 feet. The other development work included 1,975 feet of driving, 5,045 feet of crosscutting and 10,500 feet of diamond drilling. Air, water and power are purchased from the Wiluna Gold Mine. The plant includes an electric winder, ore bin, jaw crusher, Symons cone crusher, and a fine ore bin. Diesel locomotive engines will convey the ore in trucks from this ore bin to the Wiluna main shaft.

The Emu Gold Mines, Ltd.—This is the name now given to the old Waroonga mine, near Lawlers, which is being operated by the De Bernales Group. The mine has been unwatered to the No. 3 level and the shaft reconditioned to that depth. The cleaning up of the old workings is in progress and six diamond drill holes have been put down on the lease aggregating about 6,000 feet of boring.

Murchison Goldfield.

The Ingliston Consols Extended.—The Ingliston Consols Extended, which is the principal producer at Meekatharra, continued normal operations and mined and treated 41,689 tons of ore, yielding 7,982.86 fine ounces. The syndicate also acquired the Ingliston Alberts mine from Messrs. Walsh, Gerriek, and party.

The Ingliston South Mine.—A 300 h.p. Diesel engine and a Kelly and Lewis compressor with a capacity of 500 cubic feet of air per minute were installed on the mine, and a 10-head battery was renovated and put into commission.

The Big Bell Mine.—Systematic development of this large ore body was proceeded with at the 250ft. level. Satisfactory results were met with and the erection of a treatment plant to treat 1,000 tons a day has been decided upon, and a railway line from Cue to the mine is to be constructed. A separate report on this property will be found as an appendix to this report (see pages 30-34).

The Mount Magnet Gold Mines, Ltd.—The erection of the treatment plant on this mine was completed in December, 1934. For the first six months' running, 22,000 tons were treated having an average assay value of 4 dwts. 4 grs. The tonnage was subsequently increased, and for the three months September to November averaged 4,370 tons per month for 832 ozs. of gold valued at approximately £7,333 in Australian currency. This mine has an estimated ore reserve of 175,913 tons and can now be said to have been added to the list of our regular producers.

The Youanmi Gold Mines, Ltd.—This company has made a start on a large plant to treat oxidised ore and at the end of the year had completed the foundations.

The Triton Gold Mine, N.L.—At this mine the ore body at the 300ft. level, for a length of 885 feet, averaged 10.5 dwts. for a width of 69 inches. The continuation of the shoot of ore at depth has been proved by bore holes and the 425ft. level is now being developed.

The treatment plant, which consists of a modern fine-grinding plant, followed by cyanidation, and a Merrill-Crowe precipitation plant, commenced operations on September 4th, and ran continuously and satisfactorily for the remainder of the year, and although only designed to treat 5,000 tons per month, actually treated over 6,000 tons of ore per month.

This mine gives promise of being a regular producer for many years.

COAL MINING.

Coal mining was again confined to Collie. Five mines produced coal during the year, viz.:—The Co-operative, Proprietary, Cardiff, Stockton and Griffin mines. The total output from these mines was 528,854 tons, or an increase of 28,511 tons over the production for 1934. The average number of men employed was 689, being an increase of 65.

Considerably more development work was carried out than in recent years, and as a result the position at the Co-operative mine is much improved. The position at the Proprietary mine, the largest producer, is less satisfactory; extensive faulting has retarded progress. At the Cardiff mine the position is reasonably satisfactory, but at the Stockton mine is less favourable owing to faulting. At the Griffin mine a new tunnel into the workings of the old mine is almost completed. This will materially reduce haulage costs.

METALS AND MINERALS OTHER THAN GOLD.

The production of metals and minerals other than gold was again relatively small. Arsenic, obtained from the Wiluna Gold Mines as a by-product, was again the most important of these, and had a value of £54,132 as against £37,705. Reference to Part II, Table I, shown in Division I., Report of the Under Secretary for Mines, will show that there were also increases in the value of production of silver, tin, tantalite, felspar and glauconite.

GENERAL.

As far as the general position of the mineral industry is concerned, everything points to the continued and increased production of gold, for which this State is principally dependent for the value of its total mineral production.

There was at least one new find, Cox's Find, which gives promise of becoming a mine of importance.

Among the more important new producers should be mentioned the Lancefield and the Triton Gold Mines, which completed their treatment plants during the year, and the Mount Magnet Gold Mines, which completed its plant in December, 1934.

The Big Bell mine has satisfactorily developed one of the largest known low grade ore deposits of the State, and when its treatment plant is completed will be another valuable producer. Provided that gold maintains its high value, increased yields for the years 1936 and 1937 can be confidently anticipated.

I will conclude by expressing my appreciation of the good work performed by the members of my staff and of the spirit of co-operation which has existed among them. I would also like to acknowledge that much of the information relating to individual mines is taken from their Annual Reports.

RICHARD C. WILSON,
State Mining Engineer.

APPENDIX No. 1.

MINING DEVELOPMENT EXPENDITURE.

				£	s.	d.					£	s.	d.
Advances outstanding, 31st December, 1935—							Interest paid prior to 1935 ...						
Advances authorised prior to 1935 ...				238,869	4	5	Interest paid during 1935 ...						
Advances authorised during 1935 ...				2,921	0	0							
				£241,790	4	5					£26,539	15	6
Principal Moneys Advanced—							Interest outstanding at 31st December, 1934 ...						
Prior to 1935 ...				215,430	14	4							
During 1935 ...				1,794	7	3	Interest outstanding at 31st December, 1935 ...						
				£217,225	1	7							
Principal Moneys Repaid (including Sale of Securities)—							Principal Moneys Advanced ...						
Prior to 1935 ...				50,094	14	8	Less Principal Moneys repaid ...				53,827	2	1
During 1935 ...				3,732	7	5	Less Bad Debts written off ...				150,683	10	2
				£53,827	2	1					£204,510	12	3
Bad Debts written back—							Principal outstanding at 31st December, 1935 ...						
Prior to 1935 ...				147,608	12	4	Interest outstanding at 31st December, 1935 ...						
During 1935 ...				3,074	17	10							
				£150,683	10	2					£20,640	15	6

APPENDIX No. 2.

*Coal Mines Regulation Act, 1902-1926.*ANNUAL REPORT OF THE BOARD OF EXAMINERS FOR MINING MANAGERS,
UNDER-MANAGERS AND OVERMEN.

Office of the State Mining Engineer,
Mines Department, Perth,
24th March, 1936.

The Under Secretary for Mines.

The annual report of the Board of Examiners for the year 1935 is submitted for the information of the Hon. Minister for Mines.

Examinations for Certificates.

Examinations were advertised in the Press to be held in April and October, but as no candidates came forward, no examinations were held.

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

Copies of papers were received from kindred boards in England and New South Wales. There were no papers available for exchange.

We have the honour, etc.,

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

F. G. FORMAN,
Government Geologist (Member).

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

APPENDIX No. 3.

REPORT ON REQUEST FOR A RAILWAY LINE TO BIG BELL GOLD MINE.

By Mr. R. C. WILSON, B.Sc., B.E., State Mining Engineer.

Acting upon official instructions received by telegram from the Hon. Minister, I proceeded by car from Wiluna to the Big Bell Mine on Thursday, 21st November, 1935, in order to investigate and report fully on the prospects of the mine to enable the Gov-

ernment to make a decision regarding a request made by the Premier Gold Mining Company's local manager, Mr. D. L. Pitt, on their behalf, for the construction of a spur railway line to connect the mine by rail with the main Perth-Wiluna line.

This company has been testing the property by sampling, shaft sinking, driving, crosscutting and diamond drilling since December, 1932, and I understand is now prepared to give an undertaking to equip the mine with a modern power plant and treatment plant capable of treating at least 30,000 tons per month, estimated to cost £400,000 to £450,000, provided that the Government is prepared to proceed with the railway. They desire its construction at the earliest possible date in order to reduce the transport cost of plant and equipment in the first place as well as to subsequently reduce their operating costs.

The reduction of working costs to the lowest possible figure is especially necessary in this instance as the ore body is a big low grade one. As will be seen later, I estimated it to contain only 3 dwts. of recoverable gold per ton of ore treated.

Situation.—The mine is situated approximately 20 miles from Cue in a direction north 65 degrees west. A plan accompanying this report shows its exact position and that it is about an equal distance from Day Dawn.

Nature of the Ore Body and General Geology.—The ore body consists of a quartz felspar muscovite schist containing numerous quartz and pegmatite veins. Its general strike is north 25 degrees east and it dips to the east at an angle of about 60 degrees from the horizontal.

This schist in which the lode occurs is considered by Dr. Lecombe to be of sedimentary origin. To the east of the schists are typical goldfield greenstones and to the west are granites which may be expected to be intrusive. The pegmatite veins found in the lode are clearly intrusive, and are therefore younger than the sedimentary schists. Gold bearing solutions have found their way between the bedding planes of the schist and have deposited sulphides and gold. As might be expected the lode has no defined walls and values fade away gradually on either side of the payable portion of the schist.

The lode is oxidised to a depth of about 50 feet only, below which it changed quite suddenly to sulphide ore. The following notes by Dr. Simpson, Government Mineralogist and Analyst, indicate the mineral contents of the sulphide ore:—

Mr. Bowley and myself have made a few notes on the mineralogy of the gold ore in the Big Bell Mine, which will probably be of interest in regard to its metallurgical treatment. These notes are based mainly on the 167 samples recently taken by you at the 250 feet level.

In general terms, the ore consists of a thinly sheeted silvery white to pale grey, quartz-felspar-muscovite schist. The three minerals are mostly in about equal proportions, but in places the proportion of mica falls and the ore appears, deceptively, like a micaceous quartzite, but felspar is still an abundant constituent. In some specimens of the ore there is little biotite, usually accompanied by still less actinolite. The schist is traversed by very narrow veins of quartz, and quartz-microcline, or quartz-microcline-albite, pegmatite. The pegmatites are invariably parallel to the planes of schistosity, but the quartz veins are both parallel and oblique to those planes.

The whole ore body is lightly impregnated with pyrite and tourmaline, the latter in small black needles. In individual specimens small grains of chalcopyrite, arsenopyrite, stibnite, blende, galena and molybdenite were observed, whilst large crystals of rutile occurred in a pegmatite at the north

end of the open cut. In bulk samples only pyrite and stibnite occurred in determinable amounts. This is shown by the following analytical figures made on mixed samples taken right across the lode in two crosscuts:—

Lab. No.	101/36	102/36
Crosscut	257 E. and W.	251 E. and W.
	%	%
Sulphur	3.61	3.52
Antimony	.13	.09
Arsenic	.01	trace*
Lead	trace	.01
Copper	Nil	min. trace
Zinc	min. trace	Nil
Molybdenum	Nil	min. trace
Gold, dwts. per ton.	3.00	3.83

*Less than 0.005 per cent.

These figures indicate an average metallic mineral content of—

Pyrite—6.60 per cent.

Stibnite—0.15 per cent.

Arsenopyrite, etc.—traces only.

The gold values averaged 3.51 dwts. per ton and seldom exceeded 5 dwts.; only eight samples exceeded 10 dwts. per ton, the highest going 24.12 dwts.

Our observations failed to establish any relationship between the gold values and the varying proportions of pyrite and tourmaline, or the presence or absence of other metallic minerals.

Previous Operations.—The mine was operated from 1913 to 1924, during which period 64,448 tons of ore were extracted from an open-cut, yielding 10,966 fine ounces of gold or an average recovery of 3.4 dwts. per ton.

During 1928 and 1929 seven boreholes, aggregating 3,200 feet of boring, were put down to prove the continuation of the lode in length and depth. These bores are numbered 1 to 7 on the accompanying longitudinal section.

It will be seen, therefore, that we already had some knowledge of the ore body before the Premier G.M. Company began its operations.

Operations of Premier G.M. Co.—In addition to putting down another seven boreholes, Nos. 8 to 14 on the plans, the company decided to open up the ore body in the sulphide zone.

Accordingly, the shaft was first sunk to a depth of 122 feet, at which depth approximately 200 feet of driving was done and three crosscuts put right across the lode. As the values obtained in these workings proved rather satisfactory, the shaft was continued to the 250ft. level, at which depth the plan shows about 800 feet of driving which is still in progress. At intervals of 100 feet crosscuts east and west have been put out to determine the full width of the lode.

The company made a practice of taking bulk samples of the drives and crosscuts, the procedure being as follows:—

When a drive or crosscut had been extended 10 feet or thereabouts the whole of the ore broken was crushed and put through an automatic sampler as is done by companies when purchasing parcels of ore.

When finally ground and sufficiently reduced in size, the sample was divided in four portions—one for assay at the mine, one for assay at Mount Isa, one for assay by the Federal Mining and Smelting Company, Idaho, U.S.A., and one to be kept.

In addition to these bulk samples the drives were also sampled by grooves across the back at 10ft. intervals, and the crosscuts were also sampled again by grooves cut along the sides, using a small machine (popper) to cut the grooves.

The sampling of these drives and crosscuts may be said to have been most careful and thorough. Nevertheless, for my own satisfaction I did a certain amount of check sampling as set out hereunder:—

Confirmation of Mine Sampling and Assaying.—In order to be in a position to confirm the mine sampling and assaying, I decided to take a number of samples which had also been taken by the company and to compare our results. I accordingly sampled one side of each of the crosscuts at the 250ft. level in five feet sections and also the back of that level at the crosscuts.

On the assay plan accompanying this report the results as received from the Government Mineralogist and Analyst are placed in one column and the mine results taken from their assay plan are placed in another column alongside them. The result is most remarkable. Individual samples, as is usual in mine sampling, show considerable variation but the average value of the 166 samples taken by myself was 3.517 dwts. per ton, whereas the average value of the corresponding mine samples was 3.508 dwts. per ton, a difference of only .009 of a dwt. This agreement was much closer than we expected to get.

As a result I have considerable confidence in accepting as correct the balance of the sampling carried out by the company, and I feel that the results obtained by them give us as accurate an estimate of the average value of the ore as it is possible to obtain at the present time.

Sampling Results.—The sampling results which serve as a guide to the average value of the ore body may be summarised as follows:—

(1.) *Sampling at Surface.*—A detailed sampling was carried out by Bewick Moring & Co. of the number of costeans extending over a length of 900 feet, the average values being as follows:—

Costean. No.	Width, feet.	Value, dwts.
3N	80	2.4
2N	70	4.3
1N	85	5.9
1S	105	3.6
2S	110	9.8
3S	120	4.4
4S	100	4.0
5S	80	2.8
6S	86	4.2

Average value, 5.3 dwts. for 81 feet.

(2.) *Sampling at 122ft. level.*—At this level, the Premier Company drove on the ore body for 200 feet and put out three crosscuts which gave the following average value:—

Crosscut. No.	Width. feet.	Value. dwts.
1N	122	4.5
At Shaft	73.5	5.2
1S	117.5	3.5

Average value, 4.3 dwts. for 104 feet.

(3.) *Sampling at 250ft. level.*—At this depth the Premier Company were still driving and crosscutting at the time of my visit. Crosscuts extending over a length of 750 feet gave the following average values:—

Crosscut. No.	Width. feet.	Value. dwts.
4N	30	4.1
3N	58	3.1
2N	59	3.5
1N	92	3.8
At Shaft	79	3.3
1S	100	4.6
2S	109	3.5
3S	113	4.0
4S	105	2.9

Average value, 3.64 dwts. for 81.6 feet.

(4.) *Sampling below 400ft.*—The value of the ore body below 400 feet has been tested by eight boreholes as shown on the longitudinal section ranging in depth from 415 feet to 695 feet. The assay results were as follows:—

Borehole. No.	Width, feet.	Value, dwts.
6	86	4.3
7	83	3.7
8	100	3.1
9	77.5	3.7
10	55	5.6
11	92.5	3.3
12	70	2.8
13	42.5	4.3

Average value, 3.71 dwts. for 73.3 feet.

Average Value of Ore.—An analysis of the sampling results shows that while individual samples vary very considerably, the ore body when sampled in sections over a big width shows a remarkably even average grade.

As is very common in this State, there would appear to have been a certain amount of surface enrichment, but the values at a depth of 250 feet and in the boreholes below that depth show a much closer agreement than is generally obtained.

The average value of the crosscuts at the 250ft. level is 3.64 dwts. per ton, which is just a shade lower than the average value of the boreholes. This may be taken as the probable average value of the ore.

As in actual mining operations a certain amount of wall rock almost invariably gets into the ore, an allowance of, say, 10 per cent. should be made for dilution. On this basis the ore may be expected to average 3.64 less 10 per cent., or 3.28 dwts. per ton.

Amount of Ore Available.—A block of ore 750 feet long by 650 feet deep by 80 feet wide, which on the information available is a reasonable supposition, would produce three millions tons of ore (assuming 13 cubic feet of ore weigh one ton). This amount of ore mined at the rate of 30,000 tons per month, or 360,000 tons per annum, would last 8½ years, and it is satisfactory to note that similar values may be expected below that depth.

Treatment.—Treatment experiments made at the School of Mines, Kalgoorlie, show that the ore does not present any treatment troubles. After grinding to a fineness of 83.7 per cent., minus 200 mesh, a

sample assaying 4.8 dwts. per ton gave an extraction of 92.5 per cent. by cyanidation with a cyanide consumption of 0.84 lbs. KCN and a lime consumption of 1.0 lbs. CaO per ton.

Mr. Pitt claims that in their experiments a slightly higher extraction was obtained. This is, however, a fairly good extraction on such low-grade ore.

Assuming the average value of the ore mined to be 3.28 dwts. per ton, the gold recovered may be expected to be 3.03, say 3 dwts. per ton.

Profit.—The profit made will depend largely on the management. Mr. Pitt claims that after going into the figures very carefully he is confident of a total cost of 14s. per ton.

It might be mentioned here that the last operations on this mine were carried out under the joint control of the W.A. Bank and the Mines Department from August, 1922, to December, 1923, Mr. G. S. Skuthorp being the manager. During this period 22,121 tons of ore were mined and treated at a total cost of a fraction of a penny over 13s. 1d. per long ton. This ore was oxidised ore won from an open-cut, whereas future operations will be, for the most part, in sulphide ore, but bearing in mind how simple the mining and treatment will be, it seems reasonable to suppose that Mr. Pitt's figure of 14s. should be realised.

Assuming it to be correct and gold to be worth £8 per ounce the position works out as follows:—

Ore treated per month—30,000 tons.	
Gold won—4,500 fine ounces.	
Value of gold at £8 per ounce ..	£36,000
Total expenditure, 14s. per ton ..	£21,000
Profit per month	£15,000

Value of Railway to Other Producers.—An appendix to this report prepared by the Statist gives the production of all the leases which up to the present have produced gold and which will be brought nearer the railway line if the line is put through.

Reference to the statement shows that the 58 gold-mining leases on the list have produced 118,364 tons of ore, yielding 67,049 fine ounces of gold.

This total includes the Big Bell output of 64,448 tons of ore for 10,966 fine ounces of gold. Of the others, the Victory United, with an output of 31,556 ounces from 21,258 tons of ore, is easily the next largest producer, but there are quite a number of leases which have produced gold, and in particular the proposed railway line would be of benefit to the producers at Mindoolah and Weld Ranges.

It will be noted that there has been a small production of tin at Poona and Cuddingwarra, and of emeralds at Poona, and it might be mentioned that the line would pass through pastoral country.

Estimated Cost of Railway and of Receipts and Expenditure.—The Commissioner of Railways, in reporting on the proposal from a railway point of view, put down the probable cost of the railway at approximately £60,000. He estimates operating costs at 5s. per train mile or a total of £1,040 per annum. Earnings are estimated at £1,520, leaving only £480 for interest on an outlay of £60,000. It should, however, be pointed out that on the same basis of estimation the increased earnings on the Geraldton-Wiluna train will be approximately £20,000 and that this in-

crease is contingent on the Company proceeding with the enterprise. The increased expenditure may be expected to be considerably less than this amount.

SUMMARY AND CONCLUSION.

The width and value of the ore body as disclosed by the present workings and boreholes suggest that Mr. Pitt's estimate of two and a half million tons of ore above the 650ft. level will be realised and that three million tons may reasonably be expected.

The assay results obtained, and the treatment experiments carried out at the School of Mines at Kalgoorlie, indicate that the recoverable value will be 3 dwts. per ton.

Mr. Pitt anticipates a slightly better value than this—perhaps $\frac{1}{4}$ dwt. higher—but after a careful revision of the assays I do not consider it safe to assume any higher figure.

By mining and treating 30,000 tons per month of ore of this grade by modern methods under good economical management a profit of 10s. per ton may be made while gold is worth £8 per oz.

This is rather a narrow margin when an initial outlay of £400,000 to £450,000 has to be made and a further additional expenditure if the capacity of the plant is to be increased, and when it is also borne in mind that gold may fall in price below this figure.

In coming to a decision in regard to the railway, it should be remembered that the future of gold mining will depend largely on the successful working of large low grade propositions of this kind.

It is interesting to note that the plant is to be designed for the tonnage of 30,000 tons per month which is the same tonnage as the plant at the Wiluna Gold Mines was originally designed to treat.

In addition to actually employing about 500 men on the mine, a new mining township will be started and the output of the State may be expected to be increased annually by about 54,000 fine ounces of gold worth £432,000 with gold at £8 per ounce.

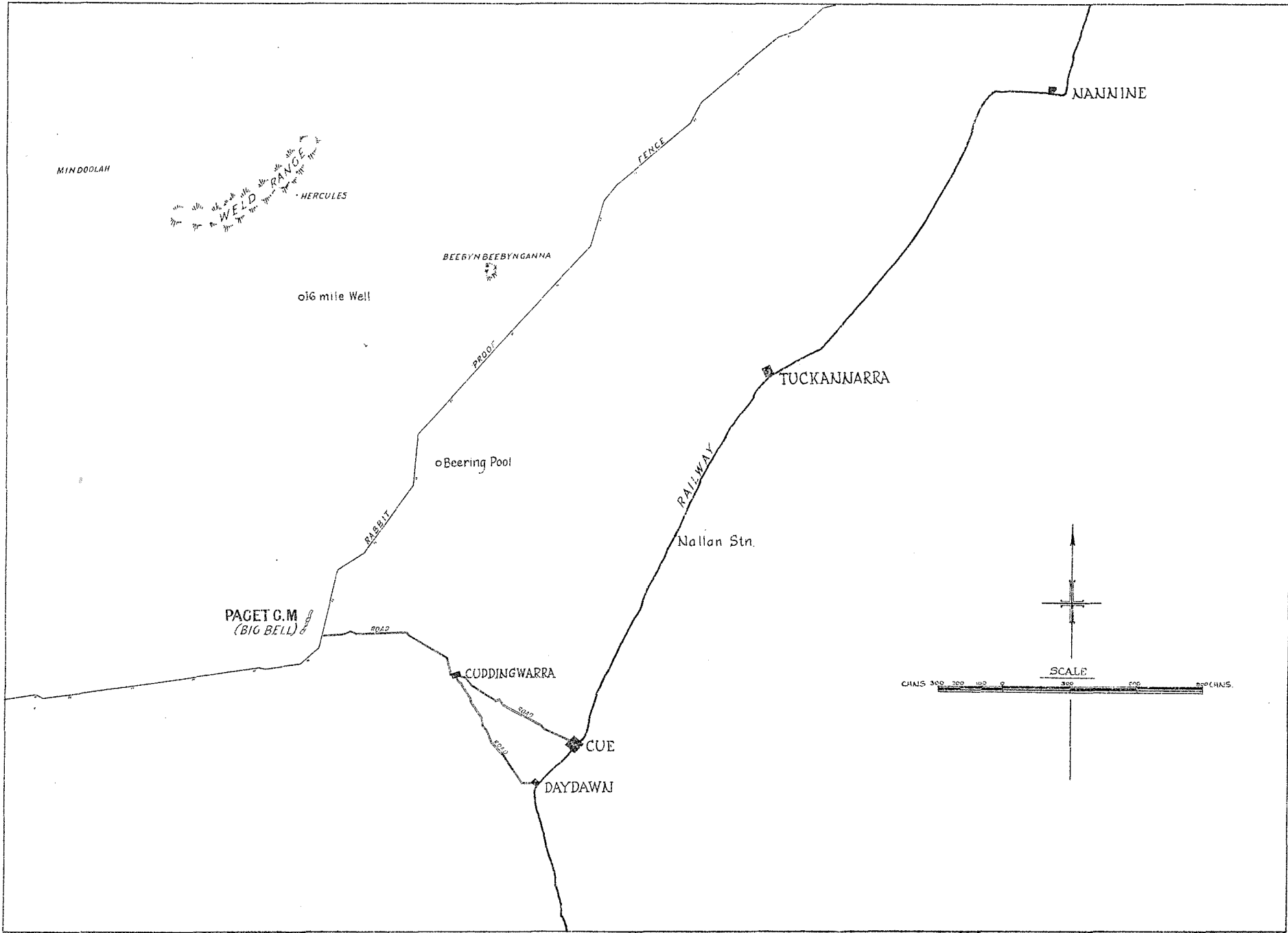
My considered opinion is that the benefit to the State of getting this mine operating on the proposed scale is such as to warrant the construction of this spur line.

APPENDIX TO REPORT ON REQUEST FOR RAILWAY LINE TO BIG BELL MINE.

Production from Leases Outside a Radius of 2 Miles of Cue and Day Dawn, North-Westward, Embracing Cuddingwarra Centre.

Name of Lease.	Tons treated. (2,240 lbs.)	Fine gold. (ozs.)
Amy Florence	176	221
Belltopper	621	168
Big Bell	64,448	10,966
Black Swan	60	125
Blue Bell	188	345
Bonanza	42	38
Chunderloo	8	17
City of Chester	1,359	1,045
City of Sydney	95	86
Clan Mac	232	197
Coodardy Reef	157	66
Emily	498	728

Name of Lease.	Tons treated. (2,240 lbs.)	Fine gold. (ozs.)	Name of Lease.	Tons treated. (2,240 lbs.)	Fine gold. (ozs.)
Fairlight	150	72	Cundy	2	63
Fingall Proprietary Ltd. (Golden Gate) ..	4,690	4,263	Double Barrel	12	10
Fortune of War	2,231	2,041	Economie	40	15
Golden Fleece	84	58	Excelsior	638	330
Gold King	55	14	Frances	60	15
Greymouth	170	445	Golden Gate	36	13
Hit or Miss	5	5	Le Soleil	297	300
Kallarua	—	33	Mindeloo	147	216
Lady Rosie	275	242	Mindoolah Main Reef ..	337	123
Laura	130	23	Mindoolah Queen	232	64
Mad Mull	816	701	Morepork	29	21
Malonno	157	143	Ned's Birthday	80	7
Moonlight	15	6	Nil Desperandum	92	48
Oxonian	174	219	Pride of Mindoolah ..	326	194
Paton's Coodhardy Re- ward	361	365	Wondery	15	10
Rhinegold	572	231	Sundry Claims	2,439	1,980
Rose	10	3	<i>Weld Range Centre—</i>		
South Victory	58	54	Weld Hercules	5,189	2,830
Victory (1354)	503	243	Tyrano	345	403
Buttercup (1109) ..	183	98	Sundry Claims	653	570
Shaughran	255	57		<u>118,364</u>	<u>67,049</u>
Royal Mint	448	387			
Scotia	932	263	Reported production of—		
Venus	—	14	<i>Tin ore</i> from Sundry Claims Poona and Cudding- warra, 4.72 tons of stream tin valued at £360.		
Victory United G.M. Co.	21,285	31,556	Value of <i>Emeralds</i> reported from M.L. 79 at Poona, 252 carats valued at £1,609.		
Whisper Low	21	20	Value of <i>Limestone</i> reported from M.L. 3 at Cud- dingwarra, 298 tons valued at £772.		
Windmill	127	63			
Sundry Claims	5,474	3,703			
<i>Mindoolah Centre—</i>					
Boggy Day	400	513			

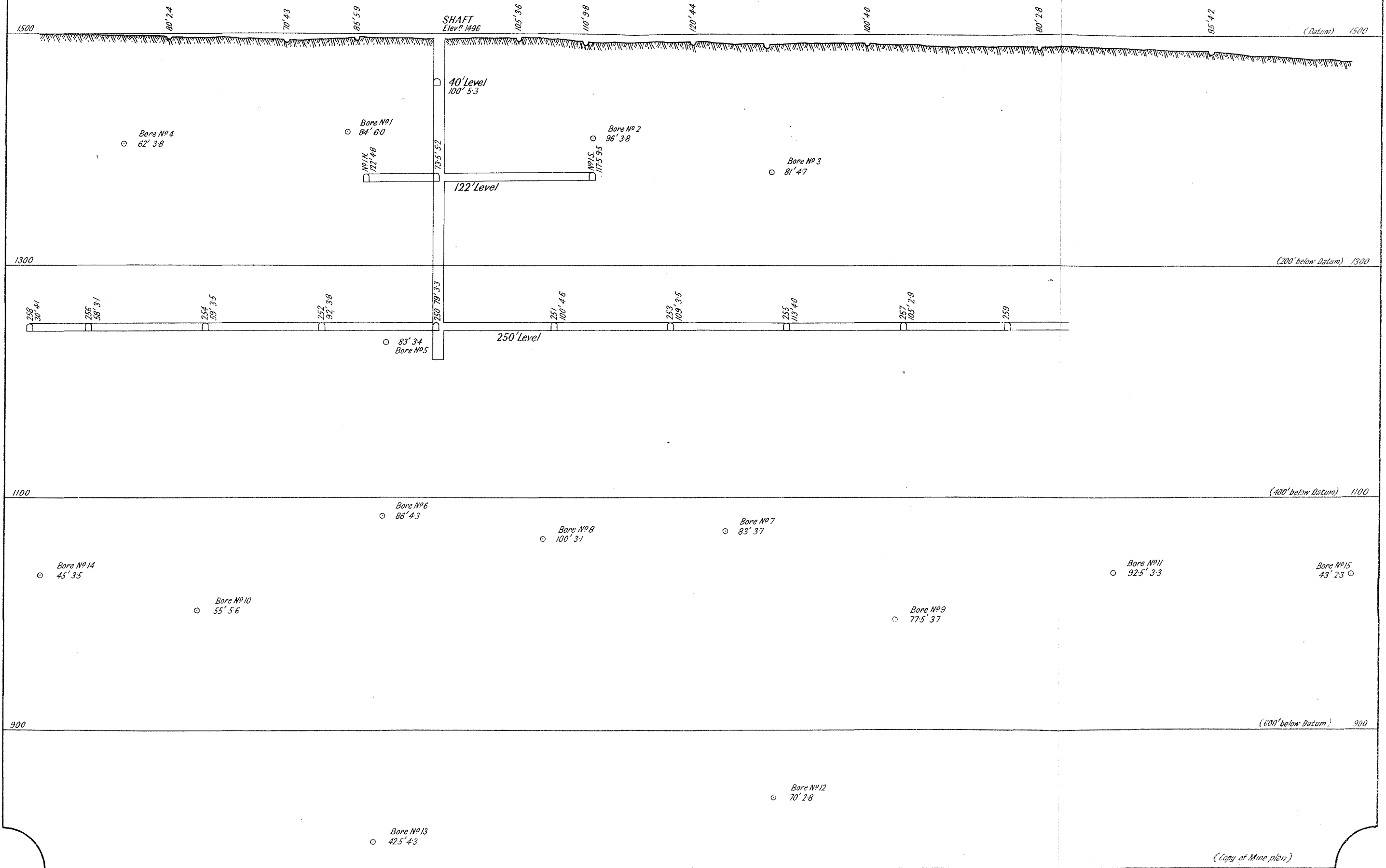
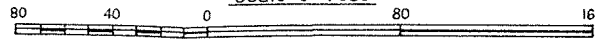


LONGITUDINAL SECTION

OF

BIG BELL GOLD MINE

Scale of Feet

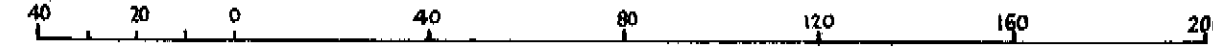


(Copy of Mine plan)

BIG BELL GOLD MINE

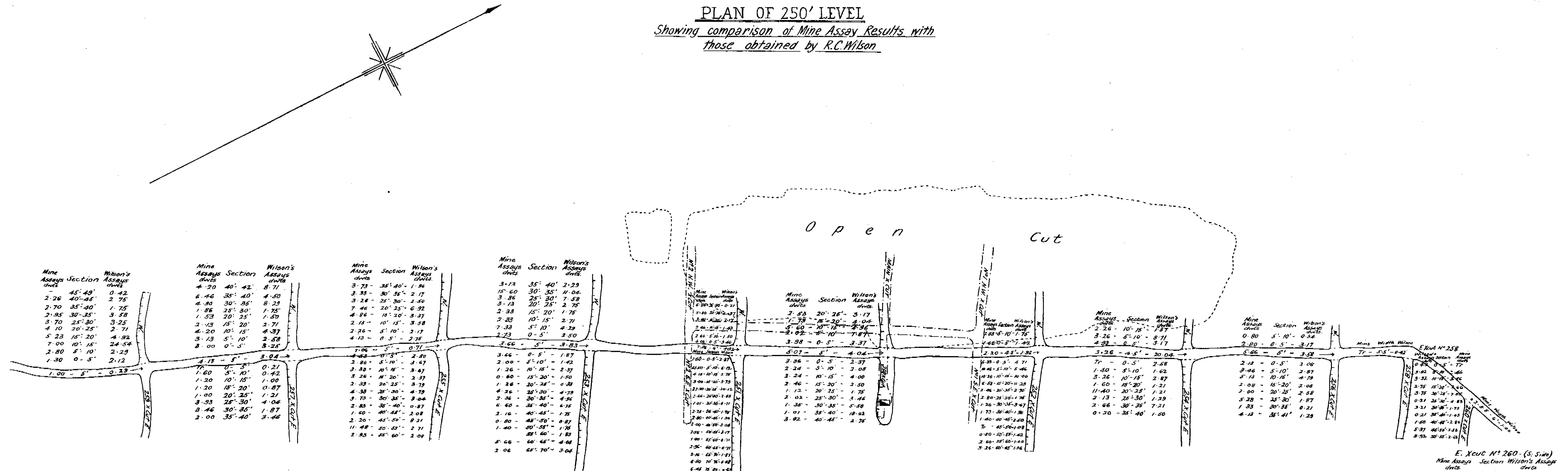
COODARDY-WESTERN AUSTRALIA

SCALE 40 FEET TO AN INCH



PLAN OF 250' LEVEL

Showing comparison of Mine Assay Results with those obtained by R.C. Wilson



Average value of Mine Assay results - 3.508 dwts. per ton

" " " R.C. Wilson's Assay results - 3.517 " " "

DIVISION III.

Report of the Superintendent of State Batteries.

The Under Secretary for Mines.

I have the honour to submit for the information of the Hon. Minister my report on the operations at State Batteries for the year ended December 31, 1935.

The tonnage handled in both sections of our plants was 210,397, comprising 108,360 tons milled and 102,037 cyanided, an increase in both sections of 10,916 tons and 7,421 tons respectively.

It is satisfactory to know that the record tonnage of 1934 has been exceeded by so substantial a margin.

The following figures indicate the increased activity in prospecting:—

Year.	Tons Milled.
1906	95,831 Record year prior to 1934.
1928	16,271
1934	97,454
1935	108,360

Value of Ore per Ton Treated.—Excluding uncompleted crushings, 108,360 tons produced 57,683.10 ozs. of bullion by amalgamation, estimated to contain 48,893.45 ozs. of fine gold, worth £207,659.12, equal to 38.32 shillings, or 9.02 dwts per ton. The average value of the tailing produced was 3,952 dwts., making the average head value of ore treated 12.96 dwts., or 55 shillings per ton with gold at 85s. per oz.

This shows a slight decline on that for 1934, when the head value was 13.32 dwts. or 56s. 2d. per ton.

Recovery.—The recovery of 9.02 dwts. by amalgamation from a head value of 12.96 dwts. is equal to 69.7 per cent.

The whole of the tailing produced was not treated during the year, but applying the average extraction for the year, namely 76.1, to the value of the tailing, the recovery was 3.007 dwts. or a total recovery of 12.027 dwts. from a head value of 12.96 dwts., equal to 92.8 per cent. as against 92.49 per cent. in 1934.

<i>Value of Production</i> —	At 85s. per oz.	Australian Currency.
	£	£
Recovery by Amalgamation	207,659	429,563
Tailing Treatment	61,267	126,747
		556,310

A comparison with the two previous years is—

1933.	1934.	1935.
£459,743	£510,876	£556,310

RECEIPTS AND EXPENDITURE.

The working account showed an expenditure of £110,858 11s. 1d., receipts at £120,770 5s. 6d., and a profit of £9,911 14s. 5d. as against an expenditure

and revenue of £98,298 13s. 3d. and £113,495 respectively and a profit of £15,196 17s. 2d. in the previous year.

The decreased profit is due to the increased wages and salaries generally and the decreased value of tailing treated.

Details of receipts and expenditure are shown in a comparative synopsis later on in this report.

MILLING.

Excluding two leased plants at Sir Samuel and Linden, one 15-stamp, four 10-stamp and sixteen 5-stamp batteries were in operation and crushed 108,360 tons of customers' ore for an estimated return by amalgamation of £429,563 in Australian currency.

The tonnage crushed was an increase of 11.19 per cent. on the record one of 1934.

No. of Parcels.—2,542 parcels of ore, averaging 40.6 tons, were treated, against 2,303 parcels and 42.3 tons respectively in 1934.

Batteries crushing over 6,000 tons for the year were Kalgoorlie, 16,870 tons; Coolgardie, 12,485.25 tons; Cue, 8,672 tons; Ora Banda, 7,790 tons; Laverton, 7,401.75 tons; Peak Hill, 6,904.75 tons.

Notable increases were again in evidence at Marble Bar and Bamboo Creek. (See Schedules I. and III.)

Stamp Duty.—The average duty per stamp for 24 hours was 4.42 tons as against 4.5 in 1934.

Milling Expenditure and Revenue.—Expenditure totalled £74,659 17s. 4d., or 13s. 9.8d. per ton, as against £66,661 7s. 10d. and 13s. 7.3d. in 1934.

Revenue amounted to £51,921 2s. 8d., or 9s. 6.8d., the figures for 1934 being £46,442 4s. 3d. and 9s. 6.3d. respectively.

With the greater tonnage one would expect a reduction in cost per ton. With returning prosperity the cost of wages, fuel and other commodities is gradually rising, and increased tonnages in the Pilbara field swell the average cost per ton.

FUEL CONSUMPTION.

It was found impossible to replace the old steam plants at Coolgardie and Laverton, as anticipated, on account of these plants being too busy to contemplate the delay necessary for the reorganisation, but at time of writing both plants are now served with wood producer plants. At Yarri the change over was made and at St. Ives the worn-out charcoal producer plant was replaced by a wood burning one, and

the general saving will be reflected in this year's costs and will more than offset the gradual increase in the cost of fuel.

The best results were:—Kalgoorlie 2.87 lbs. and 0.31 pence per H.P.H.; Ora Banda 3.62 lbs. and 0.21 pence per H.P.H., and Sandstone 3.36 lbs. and 0.26 pence per H.P.H.

TAILING TREATMENT.

No treatment was undertaken at Mt. Ida, where the tailing is refractory, and at Youanmi, where the tonnage was too small to commence on.

Nineteen plants were in operation, including Marble Bar, which commenced treatment during the year. This is the first attempt to treat tailing at this centre, and only that free from appreciable quantities of copper was treated after segregation and with success.

The average value of the tailing treated was 3.76 dwts., as against 4.03 in 1934, the residue averaging 0.90 dwt.

102,037 tons were treated, or 7,417 tons more than in 1934. The following comparative table gives all particulars as to tonnage and treatment for 1935 and 1934:—

Year.	Tons Treated.	Head Value.	Residue Value.	Extraction.	Value of Call at 85s. per oz.	Value Recovered at 85s. per oz.	Shortage.
1934 ...	94,616	dwts. 4.03	dwts. 0.937	% 76.75	£ 61,876	£ 61,747	£ 170
1935 ...	102,037	3.76	0.90	76.1	62,041	61,658	383 = 0.6%

Premium received was £65,480, or 106.8 per cent., bringing the value of bullion recovered in our tailing plants to £126,747.

The cost of treatment rose from 6s. 8.14d. in 1934 to 7s. 1d. for the period under review. Increased tonnage at Jimble Bar, Marble Bar, and Bamboo Creek, very isolated and expensive plants, and increases in wages more than offset the advantage of the larger tonnage treated and improvements made to our plants.

Revenue fell from 14s. 2d. per ton in 1934 to 13s. 5.9d., due to the lower value of tailing handled.

Tailing treatment expenditure was £36,172 12s. 8d. and revenue amounted to £68,849 2s. 10d., leaving a surplus of £32,676 10s. 2d.

I can reiterate my remarks in last year's report of the increasing treatment difficulties due to refractory material, especially that containing appreciable quantities of copper, and its incidence on the cost of chemicals and realisation charges.

The compulsory use of salt water at St. Ives and Norseman, I am glad to say, will be obviated in the near future.

The average extraction of 76.1 per cent. on a head value of 3.76 dwts. is good when one considers the difficulties mentioned above.

Value of Tailing Produced.

Most of the tailing produced was treated, the balance being the hold-over from the previous year.

Schedule 5 attached to this report segregates the tailing into three groups, payable, *i.e.*, that over 2 dwts 8 grs., for which the customer is paid; that under 2 dwts 8 grs., and that segregated as refractory.

Copper districts like Marble Bar and Mt. Ida provide the bulk of this last-mentioned group.

A synopsis on the basis of 90 per cent. of tons crushed is as follows:—

Purchased—54,771 tons, average value 5 dwts. 17 grs. = 56 per cent.

Unpurchasable—37,311 tons, average value 1 dwt. 10 grs. = 38.2 per cent.

Segregated—Marble Bar and Mt. Ida—4.311 tons, average value 3 dwts. 10 grs. = 4.7 per cent.

*Segregated—Other Batteries—1,068 tons, average value 4 dwts. 9 grs. = 1.1 per cent.

*Note.—Part will be specially treated subsequently and owners paid on actual extraction.

Comparative Synopsis of Results at State Batteries for 12 Months ended 31st December, 1934 and 1935.

	1934.			1935.		
	Tonnage.	Expenditure.	Revenue.	Tonnage.	Expenditure.	Revenue.
Milling	97,454	13/7.3	9/6.3	108,360	13/9.3	9/6.8
Tailing Treatment ...	94,616	6/9.3	14/2	102,037	7/1	13/5.9

Receipts and Expenditure.

	Tonnage.	Expenditure.	Revenue.	Profit.	Loss.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.
Milling	108,360	74,659 17 4	51,921 2 8	...	22,738 14 8
Tailing	102,037	36,172 12 8	68,849 2 10	32,676 10 2	...
Tin Treatment ... ..	...	26 1 1	...	...	26 1 1
	210,397	110,858 11 1	120,770 5 6	32,676 10 2	22,764 15 9
			Less Loss ...	22,764 15 9	
			Net Profit ...	£9,911 14 5	

ERECTION AND RECONSTRUCTION.

Marble Bar was provided with new foundations and a 34 h.p. Ruston Hornsby crude oil engine installed. A motor driven centrifugal return pump was found necessary for returning the water from a new site for copper tailing dams.

A new 15 ton a day cyanide plant was erected to treat copper-free tailing segregated over a period and 2,330 tons were treated for a return in Australian currency of £4,674.

At *Boogardie* the old National gas engine was replaced by a reconditioned Tangye engine. On account of the large tonnage of ore ready to be crushed, the engine was placed on a wooden frame bolted to the old foundation bolts, obviating the delay in building a new foundation. The engine has run successfully for some months.

At *Jimble Bar*, where the mill was idle for several months, the offices and engine room had to be rebuilt on account of the ravages of white ants.

A complete new power plant was installed at *Coolgardie* whilst the old one was in operation and is now working satisfactorily and the old steam plant scrapped.

Cue.—The tailing plant was increased by three 30-ton vats.

Laverton.—A new 10-head battery complete with rock breaker, belt conveyor and bins was commenced on a site adjacent to the old plant erected over thirty years ago. The old steam plant is being superseded by an up-to-date gas producer plant.

Meekatharra.—The charcoal producer power unit was replaced by a 34 h.p. crude oil engine and the battery renovated.

Ora Banda.—Complete new mill foundations were built and a small crude oil engine installed at the tailing plant for pumping.

Ives Find.—A complete new wood producer plant was placed in commission and a reconditioned gas engine replaced the original engine.

Yarri.—The old worn-out steam plant was scrapped and replaced by a new 50 h.p. National gas engine and wood producer. The 10-head frame was replaced by a new mill and foundations and 5 head placed in commission. When opportunity permits 10 head will be put in operation.

Mosquito Creek.—Erection Officer Emery was loaned by the Department to Mr. G. Simpson to erect a 5-head battery at this isolated centre, 30 miles north-east of Nullagine, and it has run very satisfactorily.

Details of expenditure on the foregoing works were as follow:—

	£	s.	d.
Wages	4,739	1	3
Government Utilities	6,152	16	1
Other	3,385	0	0
Total	£14,276	17	4

REPAIRS AND RENEWALS.

In addition numerous replacements by improved equipment were made at many batteries from revenue and charged against our working costs, the total expenditure being:—

	£	s.	d.
Milling	5,163	9	5
Tailing Treatment	357	5	6
Total	£5,520	14	11

ADMINISTRATION.

	£	s.	d.
Salaries	2,471	4	5
Inspection, including Salary of Inspector	943	17	7
Insurance	3,310	0	0
Printing	139	16	0
Postage	90	0	0
Superannuation, etc.	200	0	0
Total	£7,154	18	0

Administration per ton was 8.1 pence against 6.1 pence in 1934.

The item Salaries shows increases due to the partial repeal of the Financial Emergency legislation and the appointment of an Assistant Engineer. Insurance rose from £2,054 18s. 4d. to £3,310. Under this heading is included the premium covering the insurance of all our goldfields employees under the Workers' Compensation Act and an amount of £600 lump sum compensation on account of an old employee deceased before State Batteries were insured against occupational diseases.

CARTAGE SUBSIDIES.

The cost of these subsidies is steadily increasing. This increase is due to the extra tonnage, increased rail freights and longer distances carted, and a perusal of the following figures shows that the cost in the year 1935 exceeded that of the preceding year by 28 per cent., as against 11 per cent. increase in tonnage crushed and 4 per cent. in the tonnage on which subsidies were paid.

Year.	State Batteries.				Private Batteries.		Total.
	Tons Crushed.	Tons Claiming Subsidy.	Percentage of Ore Crushed.	Amount Paid.	Tons Claiming Subsidy.	Amount Paid.	
1933 ...	91,616	35,617	38.8	£ 11,040 16 1	5,953	£ 1,911 17 0	£ 12,952 13 1
1934 ...	97,454	43,163	44.2	12,193 2 8	11,459	2,846 10 6	15,039 13 2
1935 ...	108,360	52,460	48.4	17,121 5 10	12,478	3,200 11 1	20,321 16 11

The estimated value of the output at State Batteries for the year ended December 31, 1935, is £556,310, and, using the tonnage on which subsidies were paid at private batteries as a guide, the total value recovered from all batteries at which subsidies are granted would be £688,000.

STAFF.

We are still finding it difficult to obtain suitable staff, and managers have been working under full pressure. At time of writing the position has not improved, and too much responsibility has to be imposed on leading hands and rule-of-thumb cyaniders. The danger of this arrangement can be readily seen when a general decrease of one per cent. in our tailing extraction means a loss in revenue of approximately £1,200 per annum.

Numerous changes have been made. Mr. McKenzie, who, after some time in Perth on sick leave, went to Yarri for some weeks, and some months after his return to Marble Bar he was transferred to Wiluna and Sandstone, Mr. P. F. Hogg, late Boogardie, relieving him in the North-West, where he is assisted by Mr. J. Duval, who after leaving Coolgardie ran Wiluna for some months before going to Bamboo Creek. Mr. L. Thompson on leaving Bamboo Creek relieved Mr. Speering for some months at Peak Hill before going on to Ives Find, where he relieved Mr. R. E. Wann, who went to Yarri last August. Mr. F. Thomas of Mt. Ida acted for a short time at Sandstone.

The increase in constructional work, repairs, etc., necessitated the appointment of an Assistant Engineer, and Mr. R. J. Sinclair, a graduate of the Kalgoorlie School of Mines in Mechanical and Electrical Engineering, was the successful applicant.

Once again I must signify my appreciation of the excellent work, loyal service and co-operation of both Head Office and Goldfields officers.

SUMMARY.

The record tonnage of 1934 has been exceeded by 10,906 tons for an estimated yield in Australian currency of £556,360, an increase of £45,434 for the year.

The value per ton of ore crushed dropped from 56s. 2d. in 1934 to 55s. at 85s. per oz. The gross extraction was estimated at 92.8 per cent., the extrac-

tion in the tailing plant being 76.75 per cent. on a head value of 3.76 dwts., the average residue value being 0.90 dwts. per ton.

The actual recovery of £126,747 in tailing plants was within 0.6 per cent. of the call.

2,542 parcels of ore, averaging 40.6 tons per parcel, were treated.

Only 56 per cent. of tailing assayed over 2 dwts. 8 grs. per ton; 38.2 per cent. averaged 1 dwt. 10 grs. per ton, and 5.8 per cent. was refractory.

GENERAL REMARKS.

The record dry year has affected our water supplies at most batteries, more especially at Bamboo Creek, Peak Hill, Payne's Find, Norseman and Meekatharra, and though at the time of writing additional supplies are being sought, a dry winter will cause serious inconvenience.

The repeal of the Financial Emergency legislation and the general application of the 44-hour week resulted in an estimated increased expenditure of £6,000 for the year and has offset the saving in reduced power costs resulting from new installations at most plants.

From time to time requests are made by customers for a reduction in tailing treatment charges notwithstanding that the average value of the tailing is decreasing. No mention is made of the charge for crushing, which is the same now as it was twenty years ago, when wages and salaries were approximately 30 per cent. less than they are now and items like firewood considerably cheaper. It is difficult to recommend any reduction in our tailing treatment charges unless the loss on milling can be reduced. To enable any tangible reduction to be made, our five-head units, which are uneconomical to run, must be increased to at least ten-stamp plants, and at centres which do not produce sufficient ore to keep five-head plants going continuously it is difficult to recommend the further expenditure necessary. However, at the end of the present year we shall have one twenty-head mill at Kalgoorlie and six ten-head plants in operation, five of the latter being new plants. Within the next financial year it may be found advisable to duplicate the present five-head at Meekatharra.

D. F. BROWNE,
Superintendent of State Batteries.

3rd June, 1936.

SCHEDULE 1.

Recovery by Amalgamation, including Value per Ton and total value exclusive of Premium, for the year ended 31st December, 1935.

Battery.	Tons Crushed.	Gold Yield Bullion.	Value per Ton in Shillings.	Total Value.
		ozs.		£
Bamboo Creek	2,906·5	2,217·55	54·92	7,983·18
Boogardie	5,968·75	3,840·85	46·32	13,827·06
Coolgardie	12,485·25	7,556·45	43·50	27,203·22
Cue	8,672·25	4,421·05	36·70	15,915·78
Jimble Bar	644·00	150·30	16·82	541·08
Kalgoorlie	16,870·00	8,679·85	25·18	31,247·46
Laverton	7,401·75	4,085·85	39·74	14,709·06
Marble Bar	3,901·00	2,955·50	54·54	10,641·60
Meekatharra	5,433·00	3,141·55	41·62	11,307·78
Mt. Ida	2,741·50	1,102·05	28·94	3,967·38
Norseman	4,740·50	2,339·90	35·52	8,423·64
Ora Banda	7,790·50	3,769·00	34·82	13,568·40
Payne's Find	4,593·00	3,652·70	57·26	13,149·72
Peak Hill	6,904·75	1,858·10	19·38	6,689·16
Sandstone	3,041·75	1,507·55	35·68	5,427·18
St. Ives	1,923·75	583·50	20·78	2,100·60
Warriedar	2,461·00	522·70	15·28	1,881·72
Wiluna	4,850·75	2,433·15	36·10	8,759·34
Yarri	2,089·50	1,843·95	63·52	6,638·22
Youanmi	213·50	140·40	46·30	505·44
Yalgoo	2,727·00	881·15	23·26	3,172·14
Total	108,360·00	57,683·10	38·32	207,659·16

SCHEDULE 2.

Tailing Treatment, 1935.

Battery.	Tons Crushed.	Yield.	Value.	Premium.	Total Value.
		Fine ozs.	£	£	£
Bamboo Creek	3,900	713·37	3,040·69	3,213·29	6,253·98
Boogardie	5,564	867·40	3,684·50	3,944·16	7,628·66
Coolgardie	12,036	1,770·28	7,518·83	8,017·83	15,536·66
Cue	8,814	1,641·66	6,975·18	7,472·61	14,447·79
Jimble Bar	1,410	261·31	1,109·77	1,173·66	2,283·43
Kalgoorlie	16,705	2,531·84	10,751·18	11,500·09	22,251·27
Laverton	6,550	928·15	3,942·02	4,200·68	8,142·70
Marble Bar	2,330	529·63	2,278·97	2,368·13	4,647·10
Meekatharra	5,490	892·36	3,789·86	4,104·61	7,894·47
Norseman	5,264	604·24	2,567·59	2,779·41	5,347·00
Ora Banda	8,326	953·50	4,055·87	4,311·22	8,367·09
Payne's Find	5,070	262·49	1,114·59	1,180·65	2,295·24
Peak Hill	6,930	417·10	1,796·38	1,998·62	3,795·00
Sandstone	1,980	301·15	1,279·02	1,368·57	2,647·59
St. Ives	1,902	188·81	798·92	854·47	1,653·39
Warriedar	3,266	538·54	2,276·65	2,473·85	4,750·50
Wiluna	1,850	454·15	1,947·01	2,011·16	3,958·17
Yarri	810	68·80	292·15	304·89	597·04
Yalgoo	3,840	480·32	2,048·65	2,202·85	4,251·50
Totals	102,037	14,405·10	61,267·83	65,480·75	126,748·58

SCHEDULE 3.

Return showing Number of Parcels treated, and Tons crushed, at State Batteries for Year 1935.

Parcels Crushed.	Battery.	Tons Crushed.	Yield by Amalgamation.	Yield by Amalgamation, Fine Gold.	Gross Contents Tailing, Fine Gold.	Total Contents of Ore, Fine Gold.	Average per ton.	Gross Value of Ore at £4 4s. 11½d. per oz.
			ozs. dwt. grs.	ozs. dwt. grs.	ozs. dwt. grs.	ozs. dwt. grs.	dwt. grs.	£ s. d.
50	Bamboo Creek	2,906½	2,217 11 0	1,879 7 0	679 5 0	2,558 12 0	17 14	3 14 8
143	Boogardie	5,975½	3,840 17 0	3,255 7 0	1,585 9 0	4,840 16 0	16 5	3 8 10
317	Coolgardie	12,475½	7,556 9 0	6,405 2 0	2,620 13 0	9,025 15 0	14 11	3 1 5
201	Cue	8,673½	4,421 1 0	3,747 5 0	1,856 11 0	5,603 16 0	12 22	2 14 10
8	Jimble Bar	644	150 6 0	127 4 0	88 11 0	215 15 0	6 17	1 12 6
501	Kalgoorlie	16,694½	8,679 17 0	7,357 10 0	3,503 6 0	10,860 16 0	13 0	2 15 3
281	Laverton	7,329½	4,085 17 0	3,463 8 0	1,470 19 0	4,934 7 0	13 11	2 17 1
70	Marble Bar	3,907	2,955 10 0	2,505 12 0	871 9 0	3,377 1 0	17 6	3 13 2
120	Meekatharra	5,318	3,141 11 0	2,662 10 0	1,126 14 0	3,789 4 0	14 6	3 0 6
55	Mt. Ida	2,681½	1,102 1 0	934 2 0	502 12 0	1,436 14 0	10 17	2 5 5
135	Norseman	4,766½	2,339 18 0	1,983 8 0	950 6 0	2,933 14 0	12 7	2 12 2
116	Ora Banda	7,796½	3,769 0 0	3,194 16 0	1,519 3 0	4,713 19 0	12 2	2 11 4
88	Payne's Find	4,657	3,652 14 0	3,096 4 0	493 13 0	3,589 17 0	15 10	3 5 6
59	Peak Hill	7,450	1,858 2 0	1,575 0 0	710 14 0	2,285 14 0	6 3	1 6 0
89	Sandstone	2,919	1,507 11 0	1,277 16 0	586 0 0	1,863 16 0	12 18	2 14 2
14	St. Ives	1,918½	583 10 0	494 12 0	279 10 0	774 2 0	8 1	1 14 0
49	Warriedar	2,461	522 14 0	443 0 0	497 10 0	940 10 0	7 15	1 12 4
95	Wiluna	4,920½	2,433 3 0	2,062 8 0	1,222 5 0	3,284 13 0	13 8	2 16 8
33	Yarri	2,519	1,843 19 0	1,563 0 0	456 15 0	2,019 15 0	18 17	3 19 4
110	Yalgoo	2,727	881 3 0	746 18 0	381 3 0	1,128 1 0	8 6	1 15 0
8	Youanmi	213½	140 8 0	119 0 0	57 13 0	176 13 0	16 13	3 18 0
2,542		*108,593½	57,683 2 0	48,893 9 0	21,460 1 0	70,353 10 0	12 23	2 15 0

* Including incompleting crushings.

SCHEDULE 4.
Direct Purchase of Tailings.

Battery.	Tons Purchased.	Amount.
		£ s. d.
Bamloo Creek	1,851	2,609 5 10
Boogardie	3,920	4,237 6 6
Coolgardie	6,409 $\frac{1}{2}$	7,419 8 5
Cue	4,306 $\frac{1}{4}$	6,992 4 9
Jimble Bar	14 $\frac{1}{2}$	0 16 4
Kalgoorlie	8,296	10,804 9 4
Laverton	3,764 $\frac{1}{2}$	3,226 9 9
Marble Bar	1,762 $\frac{1}{4}$	2,081 7 1
Meekatharra	2,858 $\frac{1}{2}$	3,682 2 5
Norseman	2,531 $\frac{1}{4}$	2,732 14 4
Ora Banda	4,331 $\frac{1}{4}$	3,593 17 6
Payne's Find	1,160 $\frac{1}{4}$	293 1 0
Peak Hill	924 $\frac{3}{4}$	1,261 10 3
Sandstone	2,155 $\frac{3}{4}$	1,350 17 7
St. Ives	1,713 $\frac{1}{2}$	797 3 0
Warriedar	1,389	1,262 8 6
Wiluna	3,602 $\frac{1}{4}$	2,636 5 6
Yalgoo	971 $\frac{1}{4}$	1,093 0 11
Yarri	828 $\frac{3}{4}$	313 3 8
Youanmi	169 $\frac{3}{4}$	86 4 1
	52,960 $\frac{1}{4}$	56,473 16 9

SCHEDULE 5.

Return showing Tailing payable and unpayable and Gross Contents for Year 1935.

Battery.	Tailing payable.			Tailing unpayable.			Copper Tailing unpurchased.		Totals.	
	Tons.	Gross Contents.		Tons.	Gross Contents.		Tons.	Gross Contents.	Tons.	Gross Contents.
Bamboo Creek	1,602	ozs. dwts. grs. 537 18 0	850	ozs. dwts. grs. 73 9 0	...	...	...	...	2,452	ozs. dwts. grs. 611 7 0
Boogardie	4,029	1,320 17 0	1,322	95 11 0	30	10 10 0	...	...	5,381	1,426 18 0
Coolgardie	7,571	2,063 17 0	3,639	291 11 0	15	3 3 0	...	...	11,225	2,358 11 0
Cue	4,600	1,398 9 0	2,942	222 10 0	260	50 0 0	...	...	7,802	1,670 19 0
Jimble Bar	321	58 4 0	199	12 13 0	58	8 16 0	...	...	578	79 13 0
Kalgoorlie	7,992	2,670 3 0	7,032	482 16 0	...	...	...	...	15,024	3,152 19 0
Laverton	3,770	1,078 10 0	2,734	245 7 0	...	...	...	...	6,504	1,323 17 0
Marble Bar	1,568	489 15 0	41	3 13 0	1,898	290 18 0	...	...	3,507	784 6 0
Meekatharra	3,042	869 3 0	1,743	144 17 0	...	...	...	...	4,785	1,014 0 0
Mt. Ida ... ..	...	...	...	...	2,413	452 6 0	...	...	2,413	452 6 0
Norseman	2,533	706 12 0	1,665	129 13 0	95	19 0 0	...	...	4,293	855 5 0
Ora Banda	4,428	1,154 5 0	2,587	213 0 0	...	...	...	...	7,015	1,367 5 0
Payne's Find	1,152	187 11 0	3,020	250 9 0	19	6 6 0	...	...	4,191	444 6 0
Peak Hill	790	381 9 0	5,912	258 4 0	...	...	...	...	6,702	639 13 0
Sandstone	1,903	470 4 0	724	57 4 0	...	...	...	...	2,627	527 8 0
St. Ives	1,608	245 5 0	120	6 6 0	...	...	...	...	1,728	251 11 0
Warriedar	1,797	395 11 0	371	24 14 0	50	27 10 0	...	...	2,218	447 15 0
Wiluna	3,996	1,060 9 0	432	39 12 0	...	...	...	...	4,428	1,100 1 0
Yarri	1,045	280 6 0	566	56 13 0	331	74 3 0	...	...	1,942	411 2 0
Youanmi	169	49 12 0	23	2 6 0	...	...	...	...	192	51 18 0
Yalgoo	855	216 7 0	1,389	93 4 0	210	33 10 0	...	...	2,454	343 1 0
	54,771	15,634 7 0	37,311	2,703 12 0	5,379	976 2 0	97,461	10,314 1 0		

SCHEDULE 6.—MILLING AND TIN.
Statement of Receipts and Expenditure for Year ended 31st December, 1935.

Battery.	Tonnage Crushed.	Management.		Wages.		Stores and Water.		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.	£
Bamboo Creek	2,906.50	249	2 6	1,324	0 0	1,006	0 6	2,579	3 0	17 8.9	306	14 10	300	6 0	3,186	3 10	21 11	1,611	19 2	11 1	...	...	1,574	4 8
Boogardie	5,968.75	268	4 3	1,825	18 2	691	12 8	2,785	15 1	9 4	235	1 0	393	17 4	3,414	13 5	11 1.2	2,652	10 7	8 10.6	...	...	762	2 10
Coolgardie	12,485.25	522	2 11	2,322	3 2	2,820	3 10	5,664	9 11	9 0.8	557	4 5	976	15 5	7,198	9 9	11 6.3	5,866	5 4	9 4.7	...	...	1,332	4 5
Cue	8,672.25	258	11 1	2,250	15 3	1,987	11 1	4,491	17 5	10 4.3	376	4 4	575	8 0	5,463	9 9	12 7.2	4,526	4 11	10 5.2	...	...	937	4 10
Darlot	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Jimble Bar	644.00	32	15 5	398	7 4	336	13 1	767	15 10	23 10.1	150	9 6	67	1 8	985	7 0	30 7.2	402	10 0	12 6	...	...	582	17 0
Kalgoorlie	16,870.00	487	13 9	2,999	18 3	3,534	12 1	7,022	4 1	8 3.9	632	16 2	1,233	4 0	8,888	4 3	10 6.4	7,479	1 10	8 11.8	...	...	1,409	2 5
Laverton	7,401.75	242	5 11	2,069	16 8	1,543	10 0	3,855	12 7	10 4.8	365	17 2	523	2 7	4,744	12 4	12 9.8	3,759	14 6	10 1.9	...	...	984	17 10
Linden	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Meekatharra	5,433.00	315	8 7	1,752	5 1	1,218	14 7	3,286	8 3	12 1.1	264	3 11	442	0 2	3,992	12 4	14 8.3	2,525	0 1	9 3.5	...	...	1,467	12 3
Marble Bar	3,901.00	347	5 8	1,761	14 5	912	14 0	3,021	14 1	15 5.8	429	7 2	394	18 10	3,846	0 1	19 8.6	2,069	15 5	10 7.3	...	...	1,776	4 8
Mt. Ida	2,741.50	322	13 5	1,281	12 10	633	13 4	2,237	19 7	16 3.8	108	14 6	240	14 10	2,587	8 11	18 10.5	1,398	13 11	10 2.4	...	...	1,188	15 0
Mt. Sir Samuel	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mulline	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mulwarrie	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Norseman	4,740.50	389	5 4	1,934	9 5	1,015	17 5	3,339	12 2	14 1	288	11 5	536	4 9	4,164	8 4	17 6.8	2,444	9 5	10 3.7	...	...	1,719	18 11
Ora Banda	7,790.50	276	17 5	2,466	5 7	1,591	0 8	4,334	3 8	11 1.5	180	11 9	515	11 4	5,030	6 9	12 10.9	3,139	17 2	8 0.7	...	...	1,890	9 7
Peak Hill	6,904.75	217	11 10	2,108	9 4	710	19 9	3,037	0 11	8 9.5	233	0 11	387	12 10	3,657	14 8	10 6.9	2,928	3 3	8 7.5	...	...	729	11 5
Payne's Find	4,593.00	237	12 8	1,640	12 6	948	4 7	2,826	9 9	12 6.6	151	19 9	309	6 3	3,287	15 9	14 3.7	2,321	17 11	10 1.3	...	...	965	17 10
Pingin	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
St. Ives	1,923.75	198	3 10	1,128	16 8	678	7 7	2,005	8 1	20 10.1	167	7 4	242	17 10	2,415	13 3	25 1.3	1,028	17 3	10 8.3	...	...	1,386	16 0
Sandstone	3,041.75	136	11 3	1,136	3 6	651	2 7	1,923	17 4	12 7.7	66	13 8	235	10 8	2,226	1 8	14 7.6	1,362	13 7	8 11.5	...	...	863	8 1
Tuckanarra	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Wiluna	4,850.75	330	0 2	1,074	14 7	668	8 2	2,073	2 11	8 6.5	294	11 0	449	1 11	2,816	15 10	11 7.3	2,353	19 7	9 8.4	...	...	462	16 3
Warrriedar	2,641.00	151	0 1	752	1 3	606	7 11	1,509	9 3	12 3.2	72	14 5	161	6 11	1,743	10 7	14 2	1,120	14 1	9 1.2	...	...	622	16 6
Yarri	2,089.50	164	6 1	1,149	19 11	905	1 6	2,219	7 6	21 2.3	194	19 6	194	19 6	2,600	0 3	24 10.5	999	19 7	9 6.8	...	...	1,600	0 8
Yalgoo	2,727.00	269	18 9	881	9 3	608	18 4	1,760	6 4	12 10.9	95	12 11	203	14 3	2,059	13 6	15 1.2	1,372	4 7	10 0.7	...	...	687	8 11
Youanmi	213.50	...	...	135	17 6	204	1 7	339	19 1	31 9.2	...	...	...	...	350	15 1	32 9.3	133	12 3	12 5.7	...	...	217	2 10
Total	108,360.00	5,412	10 11	32,395	10 8	23,273	15 3	61,081	16 10	11 3.2	5,163	9 5	8,414	11 1	74,659	17 4	13 9.3	51,921	2 8	9 6.8	422	18 3	23,161	12 11	
Tin Plant—Greenbushes	26	1 1	26	1 1	26	1 1	26	1 1
Total	108,360.00	5,412	10 11	32,421	11 9	23,273	15 3	61,107	17 11	...	5,163	9 5	8,414	11 1	74,685	18 5	...	51,921	2 8	23,187	14 0	
Total Loss	22,764	15 9	

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SCHEDULE 7.—TAILING TREATMENT.
Statement of Receipts and Expenditure for Year ended 31st December, 1935.

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.	£
Bamboo Creek	3,900	188	18 0	1,006	2 8	132	0 10	380	0 2	1,707	1 8	8 9	2 17 10	148	6 4	1,858	5 10	9 6.3	3,783	6 0	19 4.8	1,925	0 2
Boogardie	5,564	191	3 3	889	16 2	111	6 4	391	19 3	1,584	5 0	5 8.3	8 5 9	236	17 6	1,829	8 3	6 6.9	4,020	15 2	14 5.4	2,191	6 11
Coolgardie	12,036	265	11 4	1,915	16 6	134	14 5	1,125	8 4	3,441	10 7	5 8.6	34 4 0	490	5 0	3,965	19 7	6 7	8,255	18 7	13 7.1	4,289	19 0
Cue	8,814	247	0 0	1,605	0 10	163	19 7	916	13 7	2,932	14 0	6 7.8	11 1 9	352	10 8	3,296	6 5	7 5.7	6,638	1 5	15 0.7	3,341	15 0
Jimble Bar	1,410	63	13 9	398	13 5	37	2 1	180	10 10	680	0 1	9 6.9	10 9 3	51	1 6	741	10 10	10 6.2	1,668	0 0	23 7.9	926	9 2
Kalgoorlie	16,705	270	2 0	2,398	16 3	320	11 2	1,342	0 8	4,331	10 1	5 2.2	6 9 8	693	1 6	5,031	1 8	6 0.2	11,237	13 11	13 5.4	6,206	12 8
Laverton	6,550	215	7 8	890	14 10	422	12 11	473	15 7	2,002	11 0	6 1.3	9 10 1	267	4 4	2,279	5 5	6 11.5	4,735	18 7	14 5.5	2,456	13 2
Marble Bar	2,330	148	15 2	605	5 8	40	10 7	101	16 3	896	7 8	7 8.3	92 3 11	98	11 7	8 5.8	1,113	10 3	9 6.6	1,113	10 3	...	...
Meekatharra	5,490	174	11 8	1,158	14 2	68	12 2	538	2 11	1,940	0 11	7 0.8	57 9 5	329	4 6	2,226	14 10	8 1.3	4,433	1 7	16 1.7	2,206	6 9
Norseman	5,264	139	2 8	878	13 3	111	8 3	525	15 10	1,655	0 0	6 3.4	50 19 2	312	1 4	2,018	0 6	7 8	2,498	6 9	9 5.9	480	6 3
Ora Banda	8,326	239	12 8	1,601	19 7	113	12 0	703	3 7	2,658	7 10	6 4.6	24 1 0	320	12 8	3,003	1 6	7 2.5	4,784	9 7	11 5.9	1,781	8 1
Payne's Find	5,070	110	5 10	601	13 11	85	14 0	493	0 0	1,290	14 4	5 1	30 8 0	166	8 3	1,487	10 7	5 11.1	4,714	12 8	6 9.1	2,271	8 1
Peak Hill	6,930	221	3 5	1,061	14 10	67	14 4	691	5 6	2,041	18 1	5 10.7	6 11 0	268	1 7	2,316	10 8	6 8.2	3,374	5 6	9 8.8	1,057	14 10
Sandstone	1,980	55	14 2	401	5 9	26	2 6	207	16 8	890	19 1	6 11.7	6 9 2	104	7 4	801	15 7	8 1.1	3,819	7 2	18 4.5	1,017	11 7
St. Ives	1,902	67	1 7	333	3 10	72	19 1	200	0 2	673	4 8	7 0.9	1 6 4	98	12 9	773	3 9	8 1.5	1,499	6 11	15 9.2	726	3 2
Warrriedar	3,266	16	11 7	502	11 0	105	13 7	415															

DIVISION IV.

Annual Progress Report of the Geological Survey of Western Australia for the Year ended 31st December, 1935.

The Under Secretary for Mines.

I have the honour to submit for the information of the Hon. the Minister for Mines my report on the operations of the Geological Survey for the year 1935.

STAFF.

The staff was strengthened by the appointment at the beginning of February of two field geologists, Messrs. R. A. Hobson and R. S. Matheson, and a junior clerk, Mr. J. Outtrim. The staff now consists of four field geologists, a technical assistant, a junior clerk and a messenger.

FIELD WORK.

Government Geologist.—On the 15th January I accompanied the Acting State Mining Engineer to Collie to advise on a faulting problem which had arisen in the Co-operative Colliery.

In February I attended, as a member, a meeting of the Executive Committee of the Aerial, Geological and Geophysical Survey of Northern Australia which was held in Melbourne. At this meeting final arrangements were made for the appointment of staff and the commencement of field work in the various territories to be examined by the Survey.

From the 16th April to 7th May I accompanied the newly appointed field staff of the Aerial, Geological and Geophysical Survey of Northern Australia to the Pilbara Goldfield, where operations were to commence, and in the company of Mr. K. J. Finucane, the senior field geologist, carried out a reconnaissance of the mining centres which it was proposed to examine during the first field season. Returning to Perth overland from Nullagine, I spent several days in an inspection of the field work then in progress at the Abbots mining centre, Murchison Goldfield.

In June I inspected the progress of field work at South Burracoppin (Burgess' Find), and also paid a brief visit to Leonora to tender advice to assisted prospectors in that district. At the end of June I visited Yellowdine (Palmer's Find) and sampled for departmental information the Yellowdine Gold Development Company's mine.

In July I reported on mining developments at Donnybrook and sampled, with negative results, a reef recently opened up on Dee's Block, Margaret River. Before returning to Head Office, I accompanied the Assistant Conservator of Forests on a visit to various areas in the southern districts in which the Forestry Department were operating, with

the object of gaining an insight into their problems and finding in what ways geological investigations could be of service in their solution. Immediately on my return to Perth I visited Mundaring to discuss problems which had arisen in connection with the Forestry Department's pine plantation at Mundaring Weir.

During August I made an extended tour of many of the central goldfields in company with Professor Clarke, of the Department of Geology, University of Western Australia. Many of the centres visited had not been seen by me previously, and I was able to take full advantage of Professor Clarke's wide experience as a former member of the field staff of the Survey. The results of this trip were a better understanding of many problems in the regional geology of the State and a better appreciation of the need of geological survey work in many districts.

In September I inspected the progress of field work on the re-survey of the southern portion of the Yilgarn Goldfield; and in the company of the Chairman of the Executive Committee and Executive Officer of the Aerial, Geological and Geophysical Survey of Northern Australia, I inspected the progress of the work being undertaken in the Pilbara Goldfield. Before returning to Perth I accompanied Mr. Finucane on a reconnaissance of the West Pilbara district in order to formulate plans for additional field work in that district during 1936.

In October I accompanied the Hon. the Minister for Mines and the Under Secretary for Mines to an interstate mining conference in Melbourne, and at its conclusion attended a meeting of the Executive Committee of the Aerial, Geological and Geophysical Survey of Northern Australia, also in Melbourne.

In November, at the request of the Engineer for Country Water Supplies, I chose a number of bore sites for water in the Wialki-Bonnie Rock district in the north-eastern wheatbelt.

In December I commenced an examination of the lode system on the Ora Bauda Amalgamated Co.'s property at Grant's Patch, the completion of which has had to be deferred. On my way back to Perth I visited Londonderry to obtain specimens for a proposed exhibit of the State's commercially valuable mineral deposits and inspected the progress of field work at Marvel Loch, Yilgarn Goldfield.

The remainder of my time was fully taken up in administrative and routine duties at Head Office.

F. R. Feldtmann, Field Geologist.—During the year Mr. Feldtmann has been solely occupied in the preparation of a report on the western portion of the Boulder Belt. A breakdown in health necessitated his taking long service leave during the period between the 5th August and the 4th November.

H. A. Ellis, B.Sc., A.O.S.M., Field Geologist.—During January and February Mr. Ellis was engaged on field and office work in connection with a gold discovery at Mullewa, and water supply problems at Edwards' Find, Cave Rocks, Logan's Find, and Spargoville.

In March he carried out investigations on building stones from Moora for the Public Works Department, ore and rock specimens for the general public, and the preparation of field-sheets and the compilation of information preparatory to undertaking a detailed geological survey of the Abbots Mining Centre, Murchison Goldfield.

During April and May he made a detailed geological survey of the Abbots Mining Centre, embracing an area of about 40 square miles, and whilst in the Murchison district, located bore and well sites for pastoral and mining interests.

During June and July he prepared reports and plans on the Abbots survey and water supply work, and made preparations for the re-survey of the southern portion of the Yilgarn Goldfield.

From August to November Mr. Ellis was engaged on field work in the Yilgarn Goldfield; and on completion of annual leave on December 18, compiled maps and collected information for a proposed journey to the vicinity of the Petermann and Rawlinson Ranges near the South Australian border.

R. A. Hobson, B.Sc. (Hons.), Geologist.—From his appointment on the 28th February until near the end of May, Mr. Hobson was engaged at Head Office mainly on the preparation of field sheets and compilation of data for field work at South Burracoppin (Burgess' Find) and the southern portion of the Yilgarn Goldfield. He also prepared a Summary of Petroleum Exploration in Western Australia.

From 21st May to the end of July he was engaged in field work at Burgess' Find and the preparation of maps and a report on this centre.

From 24th July to 15th December he was engaged in field work on the re-survey of the Yilgarn Goldfield.

The remainder of Mr. Hobson's time was taken up by office work in connection with the Yilgarn survey and the preparation of a progress report on centres examined by him during the course of the field work.

R. S. Matheson, B.Sc., Geologist.

Mr. Matheson was appointed on 1st March and for a month was engaged compiling base maps and other information for the Abbots survey. In addition, he assisted with routine work in the office.

During April and May he assisted in the detailed survey of the Abbots Mining Centre.

In the early part of June he assisted with the field work at Burracoppin, and during the remainder of June he was engaged in miscellaneous drafting work and the examination of bore cores.

From August to December Mr. Matheson assisted with the Yilgarn re-survey, and on his return to Head Office late in December, prepared a progress report covering centres examined by himself in the Yilgarn Goldfield.

HEAD OFFICE.

Miss B. M. Bowley, B.Sc., Technical Assistant.

Miss Bowley's duties have been heavy during the twelve months under review owing to the continual increase in volume of inquiries from the general public, and the great increase in clerical work brought about by intensive field work by other members of the staff. She has kept up to date the various technical records of the Branch, and as time permitted made progress with a reorganisation of the geological museum.

Reports following on the field work of the staff are attached, except where such were made for purely departmental purposes.

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

F. G. FORMAN,
Government Geologist.

YELLOWDINE GOLD FIND.

By F. G. FORMAN, B.Sc.

Since my first inspection of the Yellowdine find (November, 1934) development has been sufficient to enable a better idea to be obtained of the shape and size of the reefs on the principal prospecting areas, P.A. 3546 (Whindfield's) and P.A. 3547 (Egan's).

P.A. 3546.

In my first report it was suggested that two parallel reefs existed near the north-east corner of this area. Two shafts, No. 2 and No. 3, have since been sunk, respectively on the western and eastern exposure of quartz. The shafts are 67 feet apart and are connected at a depth of 50 feet by a crosscut which has exposed a width 56 feet of quartz carrying high values. At a point 26 feet from No. 2 shaft and 41 feet from No. 3 shaft prospecting drives have been put in north and south from the crosscut.

The northern drive is in quartz for a distance of 27 feet at which point the contact between the quartz and the country rock is dipping south at an angle of 65 degrees. The eastern wall of the drive from about ten feet back from the face is in country rock (quartz-mica schist) which separates the main quartz body into two portions in this space.

The southern drive has been put in a distance of 53 feet, the quartz again split near the face by a well-shaped mass of quartz-mica schist. At the face of the drive the western body of quartz turns sharply to the west, its contact with the country rock dipping south at an angle of 50 degrees. The behaviour of the quartz on the eastern side of the drive cannot be judged until further driving is done.

What was described in the first report as two parallel reefs is therefore a solid mass of quartz fifty-six feet in width from west to east and eighty feet from north to south. The eastern and western walls of the quartz mass are both dipping inwards at steep angles while the dips of 65 degrees on the northern end and 50 degrees on the southern end indicate an increase in size with depth in this direction with a general southerly pitch.

In No. 9 shaft, 136 feet south of No. 2 shaft, a quartz reef 11 feet wide at a depth of 44 feet from the surface has been driven on for a distance of about 20 feet to the north. Judging by its strike and the position of a body of quartz exposed in a costean between Nos. 2 and 9 shafts, this quartz is almost certainly a southern leg or extension from the large quartz bulge exposed between Nos. 2 and 3 shafts. This reef is probably the same as that exposed in No. 4 shaft, 70 feet south of No. 9, but No. 4 shaft was not examined during this visit.

P.A. 3547.

The main reef on this area, referred to in the previous report as Egan's reef, is being prospected by two shafts, Nos. 1 and 8, approximately 80 feet apart. No. 8 shaft was not inspected during this visit but is said to be down 51 feet. The quartz cut out in this shaft at a depth of 16 feet but is said to have been picked up again in the bottom of the shaft by crosscutting east.

No. 1 shaft has been sunk in solid quartz to a depth of 50 feet and drives north and south have been started. The quartz in this shaft contains a large amount of arsenopyrite and is similar to the quartz observed in the open-cut near No. 8 shaft during the last inspection.

North of No. 1 shaft a number of parallel and likely looking quartz reefs have been exposed in costeans, but no information as to values was obtainable.

INSPECTION OF GOLD PROSPECTING OPERATIONS AT DONNYBROOK.

By F. G. FORMAN, B.Sc.

The prospecting operations are on the site of the former workings two miles south of Donnybrook townsite, and on both sides of a creek flowing from south to north, a tributary of the Preston river.

Gold was first discovered at Donnybrook in 1897 by prospectors searching for alluvial gold, and soon after gold bearing quartz veins were disclosed. A crushing of 173 tons of ore giving a return of 501 ozs. of gold led to the proclamation of an area of 1,020 square miles as a goldfield in 1899. The goldfield was cancelled in 1906 after the production of 841.76 ozs. of gold from the milling of 1,653.3 tons of ore.

A short account of the geology and a description of the mine workings as they then were is given by Mr. T. Blatchford in the Geological Survey Annual Reports of 1898 and 1899.

The creek, which divides the field into two parts, flows in a narrow alluvial flat which effectively hides the nature of the underlying rocks. On the eastern side of the creek, Blatchford describes the rocks as being massive hornblendites and gneissic granites intersected by a narrow belt of hornblende rock pass-

ing in a north and south direction throughout the length of the field. Examination of dumps from shafts sunk since Mr. Blatchford's visit shows that the rocks in this locality consist of quartzites and slates interbedded with gneisses and basic rocks resembling hornblendites and gabbros. The appearance of the gneisses suggests that they are derived from sediments as every gradation can be seen between normal quartzites and fully developed gneiss.

The western side of the creek is occupied by sedimentary rocks of Permo-Carboniferous age, which include the Donnybrook sandstone, well-known in Perth as a building stone. Outliers of the Donnybrook sandstone on the tops of several of the hills on the eastern side of the creek indicate that the sediments at one time extended right across the valley and formed a sedimentary contact with the underlying metamorphic rocks. The contact of the two series is therefore not along a fault plane as has been suggested in the past.

The first workings inspected were in the sandstones to the west of the creek where Payne and party have obtained some rich prospects in old workings at a depth of about 20 feet. Here and elsewhere in the sandstone, the gold is associated with fracture zones filled with chalcidonic silica, and in places the country rock has been altered to a quartzite. The quartz veins in these fracture zones have the appearance of having been precipitated from cold solutions in fractures or joints in the sandstone, due probably to the circulation of cold surface waters.

It was mentioned by Blatchford and was also observed by the writer that the gold is of a peculiar arborescent form—obviously the result of secondary deposition. In my opinion the gold has been derived by solution from primary deposits in older rocks underlying the Donnybrook series, and has been re-deposited in the sandstones. Assay of this gold* has shown it to be of a very poor quality, gold 49.29 per cent., silver 50.71 per cent.

The present workings on the east side of the creek are situated about 300 feet south of Camellari's shaft, and of the main shaft of the former Donnybrook Gold Mining Company. These workings are situated on the old metamorphic rocks and consist of two shafts connected by a drive at a depth of about 40 feet, in what appears to be a true lode channel. Samples taken by Mr. Desmond Brown and myself from the drive where a crushing was recently obtained, and from the crosscut at the bottom of one of the shafts, returned only traces of gold, from which it appears that the values occur only spasmodically. This fact and the presence of heavy iron oxides in the lode channel, combined with the undoubted presence of secondary gold in the sandstones to the west, suggest that this eastern line of lode is also affected by secondary enrichment, and that any primary deposits would be likely to be of lower grade than the ore obtained near the surface.

In these circumstances, an optimistic view cannot be taken of the present developments at Donnybrook. No doubt rich patches of secondary gold will continue to be found along the fracture zones in the sandstones to the west, and similar patches are also to be expected along the lode channel to the east, but there is little hope of the development of large payable deposits in the district.

* G.S.W.A. Bull. 6, by E. S. Simpson, page 9.

THE MULLEWA GOLD FIND.

By H. A. ELLIS, B.Sc., A.O.S.M.

INTRODUCTION.

Early in January, 1935, a gold find was reported in the vicinity of Mullewa, which town is situated 65 miles east of Geraldton on the Geraldton-Wiluna Railway, and 331 miles north of Perth by the Perth-Wongan Hills-Mullewa Railway. The writer was instructed to examine and report on the find, and an examination of the area was made on January 6th and 7th, 1935.

LOCALITY.

The find is situated about one mile south of the Mullewa Railway Station in undulating granite country at the head of a northerly trending drainage area in Railway Water Reserve No. 905, which feeds the Mullewa Railway dam.

The country in the vicinity is lightly timbered with Jam and Karara, and carries a fair growth of natural grasses.

HISTORY OF FIND.

From information obtained locally, it appears that the locality was the scene of a small gold find some 25 years ago, and a short line of old shallow surface workings, consisting of costeans and excavations, bears evidence to this fact.

The quantity of gold obtained then is variously stated, but the maximum amount does not seem to exceed 25 ounces. No value can be placed on any such estimate, however, as the nature of this type of gold-winning is naturally likely to lead to indefinite statements.

In December of 1934, T. Johnsen, of Mullewa, found a small piece of haematite-bearing quartz carrying free gold, lying on the surface about 40 feet away from a shallow excavation on a narrow quartz reef. This specimen stone was in such a position that it could not have been shed from the original gold-bearing formation and placed by natural processes where found.

Intensive search failed to locate the origin of this specimen, but investigations in the old workings nearby revealed a small patch of quartz amounting to a few pounds weight only, carrying free gold.

Immediately subsequent to this discovery the area was extensively pegged, and early in January some 45 Prospecting Areas had been applied for.

It is here suggested that the specimen stone found on the surface was ejected from the original formation in the old workings nearby, during blasting operations by the original prospector. At present one prospector is working on the Prospecting Area on which the find was made, but no work is being done on the other areas.

NATURE OF OCCURRENCE.

The formation on which the old workings are situated consists of a vertical quartz reef varying in width from a few inches up to 18 inches, in hard gneissic granite striking N. 30 deg. E. magnetic bearing, and parallel to the bands in the enclosing gneiss.

The reef outcrops for not more than 100 yards and is a quartz filling in a composite fracture and brecciated zone in the granite. This is evidenced by the occurrence of clean walls to the reef in some places, and by the presence of brecciated granite completely surrounded by quartz in others, in which case the walls are not well-defined. No gold-bearing quartz was seen by the writer, and the mode of occurrence of the gold in the reef was not therefore ascertainable. From the nature of the old workings, however, it would appear that small quartz leaders crossing the main formation probably carried the gold at or near their junction with the main reef. Three roughly circular holes now about 6 feet deep and much wider than necessary to mine the main formation, suggest this to be the case, and presumably, from the shallow nature of the excavations, the gold-shoots were very short but comparatively rich.

Numerous samples from the reef in the vicinity of these old workings failed to reveal any minerals other than a trace of iron pyrites when "dollied."

Three samples taken from the reef where exposed in three separate places in the old workings located over a length of 110 feet of outcrop, gave the following returns:—

No. 1.—Gold, trace; silver, trace.

No. 2.—Gold trace; silver, trace.

No. 3.—Gold, trace; silver, trace.

Assays by the Government Chemical Laboratory, Perth:—

Nos. 214/35, 215/35, and 216/35.

The gneissic granite in the vicinity of the old workings carries numerous thin barren quartz veins, some running with the grain of the gneiss, others cutting across it, and still others showing a branching habit. There is also an extensive development of large white pegmatitic quartz reefs throughout the surrounding square mile of country.

About 8 chains north of the most northerly hole on the reef which carried the gold, a quartz vein about 2 inches thick striking N. and S. magnetic bearing, and dipping steeply to the east, had been uncovered by trenching and had been sunk on. This work seems to have been done at the same time as that done on the other old workings, but the shaft is now only about 15 feet deep with the quartz vein showing in the south side of the shaft only.

A sample from this vein gave the following returns:—Gold, trace; silver, trace.

Assay by Government Chemical Laboratory, No. 213/35.

A small quantity of iron pyrites occurs in the quartz of the formation containing the old workings.

The country surrounding Mullewa is composed of Pre-Cambrian granite and gneissic granite. In a railway cutting a few chains east of the Mullewa railway station the granite is seen to be highly sheared and jointed, while further to the south in the vicinity of the gold-find, it is in places a normal massive granite, and in others a gneissic granite with a pronounced development of large felspar crystals.

About one mile south of the Mullewa railway station, the bands in the gneissic granite strike N. 30° E. magnetic bearing. Other strikes of sheared

granite in this locality varied between N. 20° W. and N. 30° E. magnetic bearing. Here the granite is invaded by a series of narrow dykes of fine-grained basaltic dolerite and one larger dyke of medium-grained quartz gabbro.

These basaltic dolerite dykes are parallel to the direction of the schistosity in the sheared granite, and to the bands in the gneiss, and though the orientation of the larger quartz gabbro dyke could not be so easily determined, it has every appearance of having a similar or nearly similar strike. These dykes are jointed, but are not in any way sheared, and the finer grained basaltic dolerite type carries sparsely distributed blebs of iron pyrites in fine granular aggregates.

Both dyke-rock types appear remarkably fresh in hand specimen and in thin slice.

An extensive development of white quartz reefs associated with the final products of consolidation of the granite is a conspicuous feature of the country in this locality.

Another interesting feature is the occurrence in the vicinity of the gold-find of a band of highly contorted hornblende schist devoid of quartz reefs and about 20 feet wide, which follows the strike of the sheared granite. This is only about 200 feet long, and at its northern end gradually passes into gneissic granite. In places it is a typical crenulated hornblende schist, and a thin slice observed under the microscope is seen to consist of a bladed form of blue hornblende, granular epidote, albite feldspar, and a little platy quartz.

This occurrence is conceivably a remnant of a once much more extensive formation, the balance of which has been assimilated by the invading granite.

The abnormal appearance of the gneissic granite in the immediate vicinity tends to support this view.

The development of this hard gneissic granite is restricted to a narrow belt east of this schist formation; elsewhere the granite is more of the normal type, massive and sheared.

Some mica schist seen in the dump of the Mullewa well west of the railway station may be another remnant of a formation of which the hornblende schist was part, or it may on the other hand be an intensely sheared granitic formation.

PROSPECTS OF THE AREA.

In an area of about one square mile of country surrounding the find, no conditions simulating those obtaining in the immediate locality of the old workings were noticed. There are no other known gold-bearing formations in the district, and the one in which the gold has been found is very small.

Narrow leaders carrying gold may still be found in the immediate neighbourhood of the present known formation, but it is almost certain that they will be of a similar nature to the gold shoots already found and worked out.

There is consequently not much likelihood of any further extensive finds in this locality.

REPORT ON THE DOMESTIC AND BATTERY WATER SUPPLIES AT SPARGOVILLE, LOGAN'S FIND, CAVE ROCKS, COOLGARDIE GOLDFIELD, W.A.

By H. A. ELLIS, B.Sc., A.O.S.M.

INTRODUCTION.

Spargoville, Cave Rocks and Logan's Find are gold-mining centres situated south of Coolgardie and in the following relative positions:—

Spargoville.—About 20 chains west from a point situated about 28 miles S.E. from Coolgardie on the Coolgardie-Norseman road.

Logan's Find.—About nine miles in a direct line S.S.W. from Spargoville.

Cave Rocks.—About six miles E.N.E. in a direct line from Spargoville, and about 2½ miles E. from Yilmia Trig. Station.

There are no existing natural domestic and mining water supplies at any of the localities, and investigations, the results of which are embodied in this report, were made by the writer with the object of ascertaining the possibilities of obtaining such supplies locally. At Spargoville domestic water is brought from Coolgardie, a distance of 28 miles.

At Logan's Find, domestic water is brought from Larkinville railway siding, a distance of seven miles, or from an uncovered surface dam five miles east of Logan's Find.

At Cave Rocks, domestic water is obtained from Coolgardie, a distance of 31 miles.

SPARGOVILLE.

At the time investigations were made here (January 17, 1935) the population at this locality was 30, and mining operations were being carried out on an auriferous shear zone in sericite schist.

The property is being developed by the Spargo's Find Gold-mining Syndicate by sinking, driving, and crosscutting on the auriferous formation, which is of a low grade nature. An estimate made by the management of the value of about 50,000 tons of ore at grass and developed in the workings is 8 dwt. per ton. The deepest shaft was 70 feet deep as on January 17, 1935, and the formation has been traced over a length of about 400 feet horizontally, but not sufficient development work has been done to determine the nature of the distribution of the ore-shoots nor their quality. The mine in its present stage of development does not give the impression that it is likely to turn into a big producer.

PROSPECTS OF OBTAINING LOCAL DOMESTIC WATER SUPPLY.

Spargoville is situated on relatively high, heavily timbered country at the head of one of the drainage systems entering Lake Lefroy from the west. The rock types throughout this area are metamorphic sediments and metamorphic basic igneous rocks of Pre-Cambrian age, with but a small development of recent alluvium and soil-filled depressions.

The rainfall of the locality is approximately 10 inches per annum, falling mostly during the winter months—April to October inclusive. The nature of the rainfall is such that the quantity falling at any

one time is small, and insufficient to enable a reasonable proportion of it to enter the ground-water zone. The heavy forest growth makes big demands on the water entering the soil, and this, combined with the effects of evaporation and the general impervious nature of the underlying rocks, leads to only a small proportion of the rainfall entering the ground-water zone.

In areas such as that under discussion where we have only a small rainfall of a seasonal and generally scattered nature, a high annual evaporation rate, a heavy growth of forest trees and scrub, and a general impervious nature of the underlying rocks, the underground water is almost invariably saline and scanty in quantity.

For the occurrence of fresh or moderately fresh underground water suitable for domestic purposes under such conditions as just enumerated, the following natural circumstances must exist:—

- (1) A catchment area free or nearly free from vegetation on which the rainfall can be collected and concentrated with a quick run-off.
- (2) Suitable loosely consolidated sediments into which the concentrated run-off from this area can be received and stored.

The fundamental principle connected with these conditions is the rapid collection and storage of the accumulated waters, thus rendering the agencies of evaporation and transpiration ineffective.

Bare granite and occasionally greenstone areas do provide the first requisite in some districts, but the occurrence of condition (2) is less frequent, though weathering products of granite areas are capable of providing it, and frequently do so in wide granitic terrains.

The capacity of these underground reservoirs is seldom large, depending on the porosity, shape and extent of the formation holding the water.

An extensive search in the vicinity of Spargoville failed to reveal the existence of any such structures, and there is no possibility of the occurrence of any fresh ground-water in the district unless the two conditions enumerated above exist.

PROSPECTS OF OBTAINING LOCAL BATTERY WATER SUPPLY.

Water necessary for treatment purposes in metallurgical plants is not so restricted as regards quality as that required for domestic uses, and consequently the geological conditions necessary for its accumulation are not so limited as those applying to the latter.

Nevertheless, a definite set of conditions is necessary, and in a low rainfall area such as in that under investigation, the limits to these conditions become narrower.

As previously mentioned, the nature of the underlying rocks at Spargoville is not such that a rapid absorption of the rain that falls can take place. The metamorphic series of sedimentary and basic igneous rocks is not a very porous medium, and access for water to the ground-water reservoirs must take place through the medium of joint-planes in the bed-rock. There is no indication of extensive jointing in these rocks in this district, and as such a condition is necessary for the admission of large quantities of

rain-water to the ground-water reservoirs, thus ensuring a reasonably shallow supply, it is fairly certain that the distance to ground-water will be moderately deep. It is also probable that the capacity of any shaft or bore-hole sunk to the ground-water will be very small.

Undoubtedly, once the zone of saturation has been reached, mining operations in the nature of crosscuts and drives will, by intersecting more water-bearing joints, improve this capacity, but for the immediate requirements of Spargoville these facts are not of use. If the future development of the formation at Spargoville leads to the extensive penetration of the upper 300 feet of the rocks enclosing the lode, it is probable that supplies of water suitable for metallurgical purposes will be found.

The extensive growth of forest over the whole of this area requires millions of gallons of water that would otherwise find its way to ground-water level, and in the course of mining operations much of this forest will be destroyed, thus augmenting the already meagre water supplies to the underground reservoirs.

While the killing of the forest trees undoubtedly promotes run-off with accompanying soil erosion, the water that does soak into the ground is free to make its way downwards, and it is generally held that the balance between transpiration and absorption as disturbed by the process of clearing the forest growth on an area is greatly in favour of absorption in the process of final adjustments.

Evaporation is also increased by the absence of the vegetation, but during the winter months, when most of the rain falls in this district, this factor is not paramount to transpiration.

The deepest shaft at Spargoville is 70 feet, and there is only a slight moisture content in the softer parts of the formation at this depth. The rocks are not extensively jointed where seen in the mine workings, and they do not show indications of having been water carriers when they do occur.

There is no prospect of obtaining useful supplies from bores of even large diameter, and for the immediate requirements of Spargoville it seems that underground sources cannot be looked to for the provision of water for treatment purposes.

PROVISION OF BATTERY AND DOMESTIC WATER SUPPLIES BY SURFACE DAMS.

The topography of the country to the north and west of Spargoville is such that a catchment area sufficient to supply a million gallon dam is available, and a dam site situated about 30 chains south of the mine would necessitate only a small lift to place the water in storage tanks at the mine.

The nature of the ground for holding purposes would have to be investigated, but in view of the fact that this seems to be the only method available for securing domestic and battery supplies, the water catchment area would have to be investigated from many angles, and this work would naturally fall to the Goldfields Water Supply Department if such assistance were contemplated. From a geological point of view it would be advisable to secure capacity in such a dam by depth instead of surface extent, and from the high rate of evaporation (about 12 feet per annum) it would be essential that such a dam be covered.

In securing the necessary depth, it is doubtful whether the soil and underlying rock would prove efficient holders under the increased pressure, and lining of the dam with concrete might have to be resorted to.

The nature of the water likely to be collected in such a dam can be gauged from the following analyses of water from uncovered surface dams situated not far from Spargoville:—

	Lab. No. 407.	Lab. No. 408.
	Grains per Gallon.	
Total soluble salts ..	19.6	19.3
Sodium chloride (calculated from chlorine) ..	3.2	3.2
Nitrogen as nitrite ..	nil	nil
Nitrogen as nitrate ..	.034	.046
Oxygen absorbed in 4 hours from $KMnO_4$..	.37	.29
Reaction pH ..	7.6	7.8

Analyses by Government Chemical Laboratory.

No. 407 was from an uncovered surface dam two chains east of the Coolgardie-Widgemooltha Road, 38 miles from Coolgardie.

No. 408 was from an uncovered surface dam five miles east of Logan's Find, which place is situated 35 miles from Coolgardie on the Coolgardie-Norseman telegraph line.

Cattle had access to both of these dams and caused organic pollution to such an extent as to render the water unfit for human consumption. The Government Analyst recommended treatment of such waters as these with bleaching powder or sodium hypochlorite before use by human beings.

From the results of these analyses it will be noticed that the amount of total soluble salts is very low, so low as to impart no appreciable taste to the water. As both of these dams were uncovered it is safe to assume that a fairly high-grade potable water of very low salinity could be obtained in dams that were adequately covered and protected from rabbits and stock of all descriptions.

The water from both of these dams has been used at intervals by the mining population of the district, but has been found to adversely affect the health of the consumers.

From the nature of the pH reactions these waters are alkaline, though not excessively so, and there is no quality exhibited in the analyses that would render such water unsuitable for metallurgical purposes.

The cleaning of the forest in the catchment areas would have the effect of increasing the run-off, but would also temporarily increase the salinity of the water, but not to such an extent as to render it unfit for domestic purposes. In the course of time an improvement in the quality of the water would be effected.

LOGAN'S FIND.

This locality, situated near the 35-mile peg on the Coolgardie-Norseman telegraph line and about 9 miles in a direct line S.S.W. from Spargoville, occupies much the same position topographically as does Spargoville.

At the time of inspection, January 19, 1935, the only mining work in progress here was that being done by two prospectors, though considerable work has been done in the past in this locality. Several properties here, on which shafts, the deepest of which is said to be 200 feet, have been sunk, are under exemption, and the immediate water requirements are therefore those of the two men at present on the field.

These men obtain their water from a dam situated about 5 miles east of the main workings (an analysis of this water is shown under Lab. No. 408), and also occasionally from a well at Emu Rock in the same locality. Neither of these waters is satisfactory for domestic purposes, that from the dam on account of organic pollution, and that from the well on account of its reported high salinity. When the population of this locality was greater, water was obtained from Government tanks at Larkinville railway siding.

The country rock in this locality is composed of metamorphic sediments, and a fairly thick growth of forest covers the area.

The same facts as stated in connection with the occurrence of potable and saline underground water at Spargoville are likewise applicable to this locality, and from information obtained locally, the 200 foot shaft did not provide any appreciable supply of water, thus strengthening the evidence supporting the paucity of underground water at moderate depths in these localities.

To the north and west of Logan's Find, an excellent dam-catchment area exists, and a dam-site situated about 1½ miles north of the most northerly workings could be selected to impound a million gallons of water or more if desired.

As is the case at Spargoville it is suggested that the most effective and safest means of providing a domestic and battery water supply here is by means of deep covered surface dams.

CAVE ROCKS.

This locality is situated in somewhat generally lower country than Spargoville and Logan's Find, at the head of Merougil Creek, some six miles E.N.E. of Spargoville.

At the time of inspection, January 20 and 21, the locality was deserted, though indications existed that only a short time had elapsed since mining operations had ceased.

Extensive shallow workings on the line of the auriferous shear zone in sheared epidiorite exist at this locality, and from information obtained in Kalgoorlie the whole of these workings have been in low grade ore. There has been no systematic development of the ore-bodies, and no proof exists that bodies of ore sufficient to make a producing mine on a small scale are available. When work was in progress, water for domestic purposes was carted from Coolgardie, distant 31 miles.

As in the case of the other two localities, the conditions necessary for the accumulation and storage of domestic ground-water supplies do not exist here, though the topographical situation is more favourable to the occurrence of saline underground water than in either of the Spargoville or Logan's Find localities.

A very heavy growth of forest trees over most of the country surrounding the Cave Rocks area is a prominent feature, and this consumes many millions of gallons of water before it can reach the ground-water zone.

The prospecting areas were under exemption at the time of inspection, and several investigating companies were reported to be interested in the locality with a view to taking options.

A genuine attempt to locate underground water for battery purposes has been made in this locality by Mr. Kuring, owner of P.A. 3982. About half-way along the western boundary of P.A. 3982 in a depression down which water flows during storms, and which is at a general low level with respect to the surrounding country, a bore-hole was sunk by hand in fine-grained epidiorite to a depth of 145 feet, where a small supply of saline water was met with.

Mr. Kuring reports that the water rose in the bore-hole a few feet, but that the supply was very small and that the quality was that of fair stock water.

These facts are in keeping with the geological conditions under which this water occurred, as the bore-holes probably penetrated a water-bearing joint closed at its lower end. The water in such a joint, would establish static equilibrium by a fall of the water surface in the joint, with a corresponding elevation of it in the bore-hole.

These facts are mentioned because it might be inferred from the fact that the water rose in the bore-hole that an area of sub-artesian water had been located. Such an occurrence is not possible in impervious, sparsely jointed, metamorphic rocks.

A shaft was then sunk 10 feet west of this bore-hole in similar rock to a depth of 153 feet, and a drive was extended in the direction of the bore-hole for a distance of 10 feet. This shaft, sunk purely as a water shaft, failed to make a supply of water, though it is reported that there is some water in the bottom of the shaft at present.

It would appear that this shaft at 153 feet has just penetrated the upper portion of the zone of saturation, though on account of the paucity of jointing in this rock and its impervious nature it does not appear that there is any capacity in this portion of the ground-water zone.

The deepening of the shaft to 200 feet would increase the chances of cutting further water-bearing joints, but it is not probable that a good supply will be obtained even at this depth; unless in the event of more water-bearing joints being struck, extensive driving were resorted to in a direction at right angles to the strike of the joint system. This water-shaft could be turned into a reservoir by diverting storm waters into the mouth of the shaft in the event of its being abandoned at its present stage. Its situation would permit of this procedure, and in a locality where water is scarce such an expedient would provide storage for 22,500 gallons of water in a shaft 6 feet by 4 feet and 150 feet deep.

There was some possibility that diamond-drilling would be carried out in this area, and if such were the case every endeavour should be made to keep a check on underground water in such holes. As is the case at Spargoville and Logan's Find, the topographic conditions provide a fairly good catchment

area, and it is considered that a surface dam of one million gallons capacity could be obtained in close proximity to the leases.

This is the only means whereby useful supplies of domestic water will be procured at this locality, and although a deepening of the water shaft already in existence here will increase the small supply already in it, it is doubtful whether useful supplies of battery water will be obtained here under a depth of 300 feet and after extensive driving has been undertaken.

CONCLUSIONS AND RECOMMENDATIONS.

1. The areas investigated are situated in the 10-inch rainfall zone, and the rains are of the winter type, falling mainly during the months of April to October inclusive as a series of unevenly distributed showers. A thick growth of forest covers the areas, and utilises much water in its growth that would otherwise find its way to ground water reservoirs.

2. The geological conditions necessary for the collecting and storing of underground supplies of potable water do not exist at any of the three localities investigated, hence the sinking of wells and bores with the object of obtaining such supplies is useless.

3. The nature of the rocks and the distribution of their possible water-bearing structures, namely, the joint planes, is such that supplies of saline ground water sufficient for small treatment plants will not be obtained until mining development has searched a depth of about 300 feet with the necessary accompanying drives and crosscuts to intersect any water-bearing joints.

4. There is not sufficient promise shown in the metalliferous formations as at present developed to warrant the construction of a pipe-line from Coolgardie.

5. The immediate requirements of all three areas in the matter of domestic and battery water supplies could be met by the provision of surface dams.

6. In all three localities catchment areas of sufficient extent are available locally to supply at least a million gallon dam, and the quality of the water conserved in this manner would be sufficiently good to serve as a domestic supply, and the water could also be used in small treatment plants.

7. There is some good and some bad holding ground in the localities, and investigations would need to be made on the holding capacity of the ground before a dam-site was chosen.

8. As evaporation is high (as much as 12 feet per annum) any dams constructed should be sunk with the object of obtaining storage in depth rather than with increased surface area. Adequate covering for such dams would also be essential.

It is here suggested that a form of assistance to the water supply problem in these localities could consist of catchment area investigations being made and dam sites chosen by the Goldfields Water Supply Department. In this manner the run-off capacity of the respective drainage areas could be determined, and would serve as a guide to the extent to which this method of water supply could be made to serve the present and possible future requirements of the areas concerned.

REPORT ON DOMESTIC AND BATTERY
WATER SUPPLIES AT EDWARDS' FIND,
YILGARN GOLDFIELD.

By H. A. ELLIS, B.Sc., A.O.S.M.

INTRODUCTION.

Edwards' Find is a gold-mining centre situated about 25 miles nearly due south from Southern Cross and about 28 miles from that centre by road. Mining operations are being carried out here on several lines of parallel and sub-parallel quartz reefs in fine-grained greenstones, discovered on cleared agricultural country some three years ago.

At present the population of the field is 25, and the auriferous formations are being actively developed by sinking and driving, particularly on G.M.Ls. 11 and 12. Surface prospecting in the nature of loaming and costeaning is also being pushed ahead, and some promising reef outcrops have been uncovered in the area. The payable ore is carted to Marvel Loch battery some 10 miles N.E. by road, and the following returns, supplied by the owners of the claims on the field is an approximation of the ore so far treated from this locality.

From G.M.Ls. Nos. 11 and 12—			
Tonnage treated .. ..	..	..	1,864
Gold returned (ozs.) .. ..	..	..	1,183
Gold in sands (dwts.) .. ..	..	..	4
From Goodin, James and Nelson's Leases east of G.M.L. No. 12—			
Tonnage treated .. ..	..	..	421
Gold return (ozs.) .. ..	..	..	553
Gold in sands (dwts.) .. ..	..	..	6

There are no existing natural domestic or battery water supplies in the field at present, water for domestic purposes being carted from Southern Cross, a distance of 28 miles. The owners of G.M.L. 12 have sunk a shaft 193 feet deep on the reef towards the southern boundary, and no supply of underground water has been met with. A shaft 100 feet deep on G.M.L. 12 perhaps slightly more favourably situated for obtaining underground water is quite dry at the bottom.

The position is now, that the provision of a battery seems justified, and the installation of such a treatment plant is being considered by the owners of G.M.Ls. 11 and 12. Investigations were made during February 20th and 21st, 1935, by the writer into the question of the possibilities of securing local supplies of water for both domestic and mining purposes, and the results are embodied in this report.

PROVISION OF DOMESTIC SUPPLY.

The country in which Edwards' Find is situated is an unmapped extension of the greenstone belt that is shown on Blatchford and Honman's map (Plate 1, Bulletin 63), as terminating locally just north of the 20-mile peg on the Parkers Road Railway Siding-Parkers Range Road, about 18 miles south of Southern Cross.

The general topography is flat to undulating, and as the locality is in the agricultural area embracing some of the Miners' Settlement Farms, much of the country is cleared. Areas not cleared carry a thick growth of salmon, gimlet, morrel and ti-tree. Edwards' Find was made on Jilbadji Location No.

450 on a portion of the block then being sown with wheat. There is a marked absence of outcrops of any description in this locality, and the surface is composed of a slightly sandy soil underlain by a clay sub-soil seen in places to be as much as 12 feet thick.

The rainfall is in the vicinity of 10 inches per annum and is of the winter type falling during the period April to October (inclusive), with occasional summer storms. There are no bare granite or greenstone areas on which the rainfall can be collected and concentrated with a quick run-off, nor are there any suitable loosely consolidated sediments into which the run-off from such areas could be received and stored. Lacking these two essential features for the collection and preservation of non-saline groundwater in areas of low rainfall and high evaporation, the country in the immediate vicinity of Edwards' Find has no possibility of providing potable groundwater for domestic uses.

PROVISION OF BATTERY SUPPLY.

As proved in a shaft 193 feet deep sunk on the reef towards the southern end of G.M.L. 12, which has just penetrated the ground water zone, and which is making only about 2 gallons per day, supplies of underground water are not easy to obtain in this locality. Unfortunately, this shaft is sunk on some of the highest ground of the leases, though it is doubtful whether a shaft sunk to a similar depth even at the lowest point on G.M.L. 11 would provide a useful supply of battery water.

The rock in the bottom of the 193ft. shaft is a compact, fine-grained greenstone, intersected by sparsely distributed flatly dipping joints. These joints are very tight, and cannot be expected to either increase in number or become more open in depth. In several instances flatly dipping strike-faults were observed cutting the reefs above the 100ft. level and causing lateral displacement of them. Such faults may well occur again below the 193ft. level, and any such fault plane would provide a zone of more highly jointed rock which would be favourable to the downward percolation of the underground water if cut in a shaft. However, unless some such favourable structure is met with in the course of sinking, the prospects of obtaining any useful supply for battery purposes within the next 100 feet of sinking are not very good.

On G.M.L. 11 there is a shaft situated in somewhat lower ground than that on G.M.L. 12 just described, and the depth to the zone of saturation will not be as much as 180 feet here. To prove this reef at a greater depth than 100 feet it will be necessary to sink this shaft, and it is probable that this locality will be the best one in which to carry out the dual work of proving the reef at depth and endeavouring to secure a water supply for the future treatment plant. Two hundred feet may not be sufficient depth to provide a useful supply even here, and once the zone of saturation is reached, driving and any cross-cutting done would enhance the supply by cutting more water-bearing joints.

The reefs where seen at 193 feet in G.M.L. 12 and at 100 feet in G.M.L. 11 are from 2 feet to 3 feet wide and carry payable values according to information supplied by the owners. The permanency and value of the formations here as exposed in the numer-

ous prospecting workings, and as revealed by the crushing returns, warrants the rapid exploration and development of the reefs above the 300ft. level. To do this, water is necessary to enable the installation of a 5-head battery to provide returns for development work.

The sinking of a shaft by hammer and drill in tough, fine-grained greenstone below the 200ft. level is uneconomical, excepting phenomenal values exist in the reef.

If sufficient water can be provided to enable machinery to be installed to permit mining operations to be extended to the stage where sufficient underground water for treatment purposes is available, then a good purpose will be served. It is considered that at 300 feet such supplies are likely to be encountered on G.M.L. 11.

At present the best solution of the water problem lies in the provision of a surface dam. It is a less costly and less risky means than that of sinking the 193ft. shaft on G.M.L. 12 in the hope of obtaining a sufficient supply in the shaft only. A bore of even large diameter and of considerable depth would not be likely to provide sufficient battery water in this locality.

PROVISION OF DOMESTIC AND BATTERY WATER SUPPLIES BY A SURFACE DAM.

An excellent catchment area on cleared ground traversed by numerous intersecting roads running in the right direction to act as drains to the proposed dam-site extends to the east, west, and south of G.M.Ls. 11 and 12. Second growth of gums and scrub is appearing on this area, and needs removing if the best use is to be made of the catchment. The surface is fairly hard over most of the area, and the shallow depth to a clay subsoil would increase the run-off during the period of the winter rains, as saturation of the surface soil would not be a prolonged process during the early part of this period. This fact is important, because it permits of the augmentation of the supply in the dam by comparatively light falls of rain.

A dam-site situated in a depression near the eastern boundary of G.M.L. 11 and about half-way along it, would be favourably situated to receive the maximum run-off. This locality was indicated to the owners, and at the writer's suggestion, the site was test-bored for holding capacity. The bore-holes revealed a depth of 12 feet of clayey material that would prove ideal holding ground. Dams situated in similar ground two miles S.W. of Edwards' Find were inspected, and the owner of these dams reports that they are in excellent holding ground.

It is suggested that a 3,000-yard dam (half a million gallon capacity) be sunk here for the following reasons:—

(a) It appears to the writer that the catchment area is capable of filling such a dam and of keeping it replenished from time to time. It is not so certain in the absence of detailed catchment area investigations that a 6,000-yard dam could be economically installed.

- (b) If the dam is to be sunk before the dry season breaks, and to be of any use during the remainder of this year it must be completed before then, a 3,000-yard dam is all that can be excavated in the time available.
- (c) If water gets into a partially excavated dam in this type of holding ground excavating will have to cease, because horses or a tractor will not be able to work in the resulting clayey mixture.
- (d) The need of a water supply for both domestic and mining purposes is urgent, and it will be better to be sure of getting this in some degree of adequacy in a 3,000-yard dam than by running the risk of having an uncompleted, 6,000-yard dam when the rains come.
- (e) There is space available behind this suggested 3,000-yard dam for the excavation of another dam if experience teaches that such an additional dam can be filled.

The maximum depth to which a dam could be safely sunk here is eleven feet below the ground surface, and a smaller 200-yard settling dam in conjunction with the main one would be a wise provision to minimise the quantity of silt entering the main excavation, thus preserving its capacity as long as possible.

The provision and proper maintenance of wing-drains in parts of the catchment area not served by entrenched road surfaces is also essential.

Clearing the second growth and rolling the softer parts of the catchment area with a heavy roller when moist will also improve the run-off.

The covering of a dam where evaporation is high (as much as 12 feet per annum), as in the case of this locality, is necessary to secure the maximum capacity from the dam.

Investigations made locally concerning the contract price of such a dam, indicate that 1s. 6d. per yard is about the lowest price at which a 3,000 yard would be excavated.

It must be borne in mind that 500,000 gallons is not the total amount of water that will be conserved in a 3,000-yard dam. Periodically, during the winter, the supply will be augmented, and if the drains are kept in good order the summer storms which are a feature of the local climate can be looked to, to augment the summer supply. Again, the usual procedure of providing a tailings dam at the battery will enable a percentage of the battery-water to be used again.

CONCLUSIONS.

- (1) Edwards' Find, a gold-mining centre situated 25 miles south of Southern Cross, with a population of 25, carries quartz-reef formations varying in width from 4 feet to 6 feet of a distinctly promising nature both in value and depth.
- (2) There are no existing natural or artificial domestic or mining water supplies on the field at present, water for domestic uses being carted from Southern Cross, a distance of 28 miles.

- (3) Geological conditions suitable to the collection and storage of non-saline ground-water for domestic purposes do not exist in the field, hence such supplies cannot be obtained from well or bores.
- (4) The occurrence of saline ground-water in sufficient quantity for battery purposes is not likely to be met with under 300 feet, and then only after extensive driving and crosseutting has been carried out in the course of mining operations. Bores of even large diameter are not likely to provide a sufficient supply.
- (5) An excellent cleared, road-intersected catchment area, capable of supplying at least a 500,000 gallon dam, exists at the main mining centre, and a dam-site located in excellent holding ground giving a depth of 11 feet in clayey soil is obtainable.
- (6) Although the rainfall is only about 10 inches per annum and is of a scattered nature, it is considered that the excellent catchment area will provide a good run-off, and that the dam supply will be augmented periodically during the year under normal climatic conditions.
- (7) It is absolutely essential if this dam is to be constructed for use during the coming winter, that it be commenced immediately and finished in six weeks' time. The first heavy rains, and these are likely to fall in the break of the season, are those that will fill the dam quickest from this catchment area.

RECOMMENDATIONS.

- (1) As the water from any dam constructed here will be used for domestic purposes, and as the mines will be located on the catchment area, it will be necessary for every care to be taken to destroy putrescent organic matter on the area. Dr. E. S. Simpson, Government Mineralogist and Analyst, recommends that before being consumed by human beings, the water in such dams should be sterilised with bleaching powder or sodium hypochlorite at the rate of two pounds per hundred thousand gallons. This recommendation is important and should be conveyed to the users of the water. It is also very necessary to completely enclose with rabbit-netting any such artificial waters to prevent rabbits, kangaroos, emus, and live stock in general from having access to the water.

The addition of bleaching powder or sodium hypochlorite at the rate suggested above will not provide a sufficient concentration of nascent chlorine to interfere with treatment operations using amalgamated plates.

- (2) The prospects of this field are sufficiently good to warrant the statement that any assistance the Mines Department may consider giving to the gold-mining industry in the matter of water supplies would be justified at Edwards' Find.

STONE DEPOSITS—MOORA.

By H. A. ELLIS, B.Sc., A.O.S.M.

I have to advise inspecting some buildings in Moora in which stone from the above deposits has been used.

I also made a short visit to the locality from which this stone is reported to have been obtained, and forward the following notes in connection with these observations:—

BUILDINGS.

Post Office.—Date erected not known to me. The fine-grained pink ferruginous sandstone has been used for the lower two feet of the foundation of this building. The main portion of the building is not made of either of the two specimens recently reported on by the Geological Survey, but of a rock from Griffith's quarry.

The sandstone is wearing very well and has retained its colour to a large extent. It is now pale pink, and is somewhat case-hardened. The edges are quite sharp and no structural defects are noticeable, although the sandstone is carrying the weight of the whole of the walls.

Commercial Hotel.—Erected 1909. The bottom five feet of the walls of this building are composed of the fine-grained ferruginous sandstone reported on by us, and are in perfect order to-day. The colour is pale pink and uniform in nature, and the edges are everywhere sharp. The sandstone is carrying the whole weight of a two-storey building (brick) and is not showing any structural defects (no fretting).

Wesleyan Church.—Erected 1909. Foundations consist of a layer of the fine-grained banded quartzite and the fine-grained pink sandstone reported on by us. The main building is of fine-grained sandstone. Both rocks are wearing well and are not showing any defects.

The quartzite has gone a dark purple in colour and does not look so well in a building as does the sandstone. The quartzite has been used with the bedding horizontal.

DEPOSITS.

The localities from which this stone is reported to have come are situated in a N.S. ridge about 1.8 miles east of Moora.

There is no quarry, the material having been obtained from scattered shallow excavations. Localities situated on the S. side of the road to Berkshire Valley about 1.8 miles east of Moora Post Office, and opposite a dam situated close to the road on the N. side, indicate that both types of stone could be obtained in quantity.

Exposures seen were also very much jointed, but the deepest excavation observed was only about three feet, and less highly jointed rock may be expected at a greater depth.

Access is easy, though slopes are not steep and this would add to quarrying costs.

The localities are all thickly covered with scrub, and not much time was spent seeking other exposures which must exist here.

No stone is being quarried at the present time.

SUMMARY OF THE RESULTS OF THE GEOLOGICAL SURVEY OF THE ABBOTTS MINING CENTRE, MURCHISON GOLD-FIELD.

By H. A. ELLIS, B.Sc., A.O.S.M.

The gold-bearing quartz reefs of the Abbots centre have been found to occur almost exclusively in the rocks belonging to the Kyarra Schist series, which

consist of schistose derivatives of Pre-Cambrian dolerites, gabbros and tuffs, folded along axes trending north-north-east and north-north-west; the planes of schistosity being nearly everywhere vertical, or dipping at very steep angles. Such evidence as is available points to their having been formed in shear zones in this schist, and the irregular and lenticular nature of the smaller gold-bearing reefs is definitely established.

Small local concentrations of gold in thin quartz reefs have been found from time to time in the past, but as the sites of these finds were either unknown or inaccessible, the geological features associated with them were not determinable.

The two main producers, closed down since 1904 and 1908 respectively, were the Vranizan and New Murchison King mines, in which quartz reefs were worked to a depth of about 300 feet. The old workings of these mines were inaccessible below water-level, and the ore bodies above this level have been worked out. From information obtained from persons who had worked in the mines, operations ceased below water-level on account of the absence of ore-bodies at depth; the reefs being stated to split up into thin stringers at the 300ft. level. From the only mine plan available—that of the underground workings of the Vranizan—the ore-bodies are shown to be pitching to the north, and that while the dip of the reef remained moderate, it was workable, but that when the dip steepened, either the values were poor or the reef thinned out.

From observations in the accessible parts of this mine the fact was established, that, in those reefs found to contain gold and worked in the past, the ore-shoots occupied the whole extent of the reef, and that where the stoping terminated the reef had broken up into unworkable thin stringers not carrying values.

The accessible workings of the New Murchison King showed that the same feature concerning the stoping also existed there, but as the reefs had a comparatively steep dip from the surface, a change in dip is not known to have influenced the nature of the ore-bodies in this instance. It may have done so, but since no plan of the underground workings is available, and the mine was inaccessible below water-level, nothing definite can be stated.

The shear-pattern of the reef system could not be determined on account of insufficient exposures, but the definite existence of a nearly north and south shear, and another north-west system has been established, and both carry auriferous reefs.

The country forming the Kyarra Schist has been extensively prospected, and apart from the area embraced in the strip of country about one mile long by ten chains wide, in which practically all the known payable gold deposits, both large and small, have been found, it has not yielded any other payable results.

The structure of the area examined has been tentatively determined as either a uni-lateral one, consisting of a large drag fold on the easterly limb of a northerly pitching anticline, or a bi-lateral one forming a northerly pitching anticlinorium; the balance of the evidence being in favour of the former, with the auriferous reefs occurring in or near the supposed position of the axial plane of the structure. From this interpretation of the structure, it has been suggested that other possible lines of auriferous country

may occur in the Kyarra Schists, near the eastern boundary of this formation due east of Abbots Trig. Station, and in the belt of country running north-north-east from a point situated about 2 miles west of Abbots Trig. Station. A small reef in a shear zone is at present being worked in this latter locality (P.A. 2140N).

The asbestos and copper occurrences have been found to be of mineralogical interest only, and do not constitute present or possible future payable ore-deposits.

Potable underground water was found to be present at depths ranging from eight feet to one hundred and fifty feet below the ground surface, the depth to water-level being shallower in the granite than in the greenstone country.

Neither the granite nor its associated pegmatite dykes were found to be metalliferous, and no record of any pneumatolytic minerals having been found in or near them is known.

REPORT ON PROPOSED WATER SUPPLY FOR TUCKANARRA BATTERY, MURCHISON GOLDFIELD.

By H. A. ELLIS, B.Sc., A.O.S.M.

During the course of the geological survey of the Abbots Mining Centre, Murchison Goldfield, a request was made to the writer for assistance in the matter of obtaining a suitable water supply for the Tuckanarra battery, a privately owned gold-treatment plant.

Investigations were made on the way north to Abbots and also on the return journey on completion of the Abbots survey.

The battery is situated about 30 chains west by south from the Tuckanarra railway siding, and about five chains west of a south-westerly trending drainage channel. The general nature of the topography in this locality is flat to undulating, and the rocks are of the greenstone type not readily penetrated by surface water.

The water supply in use at the time of the first visit on April 7, 1935, was being obtained from a 7-inch borehole sunk to a depth of 102 feet situated three chains east of the creek bed that trends south-west, five chains east of the battery site. Additional supplies were also being obtained from a waterhole in the creek bed near by. A windmill had been erected on the bore and waterhole. When the bore was first drilled, water was struck at 87 feet, and the hole was continued to 102 feet but not cased. A good supply is said to have been obtained from this source until the bore apparently silted up.

Even the most favourably situated boreholes drilled in greenstone country have very little chance of providing a supply of water sufficient for battery purposes, and a well sunk as close to the bank of the creek as possible, after a borehole had determined the depth to water level, and a drive towards the main drainage channel to cut the cleavage or jointing of the country rock and provide storage, would have provided an ample water supply here.

Tenders were subsequently called for this work, but the price was fairly high, and the owner of the battery thought it less costly to arrange to get a water supply from an abandoned mining shaft three-quarters of a mile distant from the battery. This shaft is said to be 250 feet deep and to possess a large storage capacity in the nature of drives.

The cost of a pipe-line for this distance, together with the necessary pumping machinery, may well exceed that of a well and drive on the site of the old bore, and this feature was pointed out to the owner.

In cases such as this, which no doubt frequently occur in the greenstone belts of the goldfields where shallow underground water is not plentiful, a definite procedure in the search for underground water for battery purposes should be followed.

If there is a drainage channel anywhere in the locality, a small diameter bore should be sunk as close as possible to the edge of the channel at the lowest practicable point. If the creek bed is a wide flat one, then the test hole is best drilled in the creek bed itself. Considerations of elevation and position, with the view to obtaining gravity supplies, must be subordinated to the major consideration of first obtaining the water. In localities where underground water is scarce, a good principle to follow is to be concerned firstly about securing a supply, and then to adapt the means of raising it to the circumstances under which it occurs. Frequently, the order of these considerations is reversed in the minds of water-seekers. Having drilled the borehole to water-level, it should be continued for at least 20 feet into the ground-water zone when this is contained in weathered greenstone rocks. A pumping test should then be applied, and even if it falls far short of the required supply, as it almost invariably will do, it must be remembered that seepage surfaces cut in a well and in storage drives will very greatly enhance the capacity of the source of supply.

If the supply obtained in the borehole is only a very moderate one, it is still advisable to sink a well on it, if the site of the bore is the most favourable in the locality. If the general trend of the planes of schistosity of the country is known, then the maximum seepage surface will be cut by sinking the well with its greater length at right angles to this direction, *i.e.*, "across" the "run" of the country. Twenty feet into the ground-water zone is not an excessive depth to carry the wall, and if a sufficient supply is not obtained then, it will be necessary to make drives from the bottom both for storage and increased capacity.

With the well located on either bank of the drainage channel, the storage drives should be cut directly towards the centre of the creek. In making storage drives in any well, the most efficient seepage surface will be cut in a direction at right angles to the bedding or planes of schistosity of the country rock, or, when these are not prominent, then in a direction at right angles to the trend of any joints, if these occur.

It is best to drive into the footwall side of the country when the bedding, planes of schistosity, or joints dip either flatly or steeply. By this means new possible seepage surfaces not previously cut by the vertical shaft or well are intercepted, with the additional prospects of enhanced supply.

To illustrate the points stressed above, a special case can be considered. Assume a drainage channel running north-east and south-west, with the planes of schistosity of the sheared greenstone running about north and south and dipping to the west at steep or flat angles. The best situation for a 6ft. x 4ft. well on such a creek would be as close as possible to the western bank, and sunk with the 6ft. side lying in an east and west direction. The storage drive would be driven in an easterly direction under the creek bed, thus cutting possible seepage surfaces some distance west of the actual point of intake in the creek bed.

The sinking of wells close to or in drainage channels in the goldfields of Western Australia may be regarded as risky on account of the occasional violent re-flooding of such depressions with the possibility of loss of the equipment. In the extreme case when it is necessary to locate the well in the centre of a wide drainage area, if care is taken to build a substantial compact dump inside a stout stub fence built of straight round timber, and hinged wooden or iron doors are provided as a cover for the well-mouth, the structure will stand total submergence without much damage being sustained beyond a slight silting of the well. The location of wells close to the bank on straight reaches of the drainage channel and on the inside curve of bends is a fairly safe procedure. Positions near the bank on the outside curve of bends should be avoided, as erosion at these points in flood times is extreme.

REPORT ON THE LOCATION OF A BORE-SITE FOR WATER AT "GNAWEEDA" STATION, MEEKATHARRA.

By H. A. ELLIS, B.Sc., A.O.S.M.

During the progress of the geological survey of the Abbotts Mining Centre, the writer's services were made available to pastoralists using Meekatharra as a centre, who were contemplating establishing new water supplies on their holdings. Owing to the depressed state of the wool market for some years past, very few improvements in the nature of new water supplies are being made by the station owners, but help was required and given to "Gnaweeda" Station in locating a bore-site in a portion of the run where underground water supplies have been difficult to obtain.

In that portion of "Gnaweeda" Station situated north-east of Gnaweeda Railway Siding on the Meekatharra-Wiluna railway, a belt of low hilly greenstone country runs N.N.E. and S.S.W., and contains, besides some auriferous deposits, some excellent pastoral land. An attempt to provide a water supply to enable some of this country to be used was made by the Gnaweeda Pastoral Company, who drilled a bore-hole in the greenstone and obtained an inadequate supply.

The situation of this bore is on the south side of a wide flat drainage channel in greenstone, 3.1 miles north along a fence which crosses the Meekatharra-Wiluna road 4.4 miles east of Gnaweeda Railway Siding. It was drilled to a depth of 140 feet through alluvium and greenstone, and water was struck at 122 feet.

The supply is reported to be 800 gallons per 24 hours, and this was not sufficient to safely water the number of sheep the paddocks were capable of carrying. An adequate supply could have been obtained here by sinking a well out in the centre of the drainage channel and making drives across the bed of the creek at a depth of, say, 150 feet. As the owners of this station possess a 6-inch percussion water-boring plant, they were anxious to find a spot somewhere not too far from the original site, where a new bore-hole could be sunk with the prospect of obtaining at least 3,000 gallons per day. It was pointed out by the writer that there was only the remotest chance of this being possible in a bore-hole drilled in greenstone country, and no structure capable of providing such a supply was noticed in this locality. Only a very exceptional structural feature would permit of this supply being obtained in a greenstone area, and it was decided to move the bore-site to granite country to the south of this locality.

A site in flat granite country situated 90 chains south and 20 chains east of the present bore in the greenstone was chosen, with the object of obtaining a supply in alluvium and decomposed granite, in what would probably be an old valley in the granite surface continuous with the drainage channel in the greenstone to the north. It is not anticipated that the depth to water level will exceed 100 feet, and the supply should prove sufficient if the bore-hole is properly cased with perforated casing after it passes into the ground-water zone. The useless procedure sometimes followed, of boring in the comparatively fresh granite when a supply has not been obtained in the overlying beds, will not be carried out in this instance, as the futility of this was explained to the owners.

Some excellent supplies have been obtained in the wide, flat alluviated granite plains in comparatively shallow bores some distance south of this locality, the bore at "Gnaweeda" homestead being a particularly good instance. The supply in this bore-hole is not accurately known, but from information supplied by the owners it exceeds 6,000 gallons per day.

There are numerous wells on this station, and many were observed to have been sunk just where water was required to serve existing fenced paddocks. The practice of fencing first and securing the water supplies afterwards, which seems to be general in the Murchison district, shows that underground water of useful domestic and stock quality is fairly general in that part of the district underlain by granite.*

REPORT ON P.A. 1855N, SITUATED ON GNAWEEDA STATION ABOUT 18 MILES EAST OF MEEKATHARRA.

By H. A. ELLIS, B.Sc., A.O.S.M.

On that part of Gnaweeda Station, situated north of the Meekatharra-Wiluna road and railway line, about 18 miles east of Meekatharra, a belt of gold-bearing greenstone outcrops as a series of low hills

* In a private communication from Mr. Lacey, part owner of "Gnaweeda," he states that water was struck at 98ft. and that it rose in the bore hole about 8ft.

Since writing this report a letter from the station owner states that at 141ft. he struck a big supply of water, the level of which could not be lowered on bailing at the rate of 10,000 gallons per 24 hours.

and ridges having a general northerly trend. This line of country probably includes Gabanintha to the south and the gold-mining leases to the north, of which the "Mistletoe" constituted a spectacular producer some years ago. An investigation of this belt was not made during the examination of P.A. 1855N, as no authority was given for an areal geological survey of this portion of the district to be made.

The brief description of the outcrops and auriferous formations contained in this report on P.A. 1855N, are the result of investigations made by the writer with the help of Mr. E. Lacey on May 14, 1935. Time did not permit of a detailed examination of the surface outcrops on the whole of the 24-acre P.A., the object of the investigations being to acquire sufficient data to enable an opinion to be formed concerning the prospects of the auriferous formations already opened up.

In the north-east portion of the prospecting area there is exposed in a low hill a belt of deeply weathered grey to brownish coloured, somewhat schistose rocks, which may be in the unweathered condition, a variety of chloritic schist. They are granitised in narrow belts which show a well-defined set of rectangular joints, and one large quartz reef, barren of gold values occurs in them. This quartz reef outcrops for about 80 feet, and is flanked on both sides by granitised schist striking N. 30 deg. E. and dipping to the east at about 60 degrees. The reef varies in width but averages about 6 feet. About 40 feet south from the southern end of this reef, a small rich shoot of gold has been found in a quartz reef which, when cut in a vertical shaft at 6 feet in depth was 11 inches wide on the north side, and 9 inches on the south side of the shaft.

This reef has been followed down for 24 feet on the underlay to the east, the dip being about 60 degrees. A shear zone about 3 feet in width contains the reef which varies rapidly in thickness, strike and dip. The formation strikes N. 40 deg. E. and dips to the east at 60 degrees. At a distance of 12 feet down the underlay shaft a big bulge of barren quartz appears on the north side, this does not cross the shaft, but continues to the bottom for 12 feet. There are no values in this formation, which appears to be a separate make of quartz to that containing the gold. A drive to the south along the thin reef for 12 feet showed the pinching out of the lens in that direction, and at 24 feet in the shaft, the original gold-bearing formation had narrowed down to 2 inches but was said to still carry gold. Some gold was obtained from the upper portions of this small formation by dollying, but no crushings are recorded as coming from it.

The general structure of this occurrence shows it to be of a decidedly lenticular nature, with the narrow shoot of gold pitching to the south. In circumstances such as those under which this shoot of gold occurred, so long as the smallest remnant of the original gold-bearing quartz persists either in length or depth and it is still carrying gold, then it is advisable to follow it. Unless the reef is showing signs of breaking up into numerous small stringers, it has always the possibility of forming another lens, and at 24 feet a quartz reef cannot be said to have been reasonably tested in depth.

At a distance of 90 feet south-west from the underlay shaft, a shaft 29 feet deep with a crosscut to the west from the bottom for 30 feet has been sunk purely as a prospecting venture. No reefs were encountered in this shaft which was inaccessible, and the country rock as seen in the sides appeared to be a very much disturbed and highly weathered schist. About 50 feet N.W. of this shaft, a large ironstone and quartz formation outcrops, and forms the summit of a low hill. The country rock is a very much oxidised schist, granitised and silicified in places, striking N. 30 deg. E. and dipping to the south-east at 70 degrees. Fine gold has been found by loaming in this formation on the north side, but no definitely gold-bearing portion of it had been discovered up to the time of inspection, May 14, 1935, at which time work was in progress.

One hundred and sixty feet west-north-west of the southern toe of this quartz and ironstone formation, a vertical shaft has been sunk in oxidised schist for 38 feet. The intervening rocks consist of very much decomposed schist, and it appears that the shaft was sunk to intercept a lode formation exposed in a shallow surface working 15 feet deep cut in brecciated quartz and decomposed green-stone schist about 20 feet N. 10 deg. W. from the shaft.

At 12 feet down the 38ft. shaft, an ironstone leader 2 to 4 inches thick, striking N. 30 deg. E. and dipping E. 30 deg. S. at 60 degrees cuts across the shaft and is said to carry gold. A network of ironstained quartz stringers is exposed in the sides of the shaft, and it is not reported that any of them carries gold.

At about 25 feet down the shaft, a defined oxidised shear zone is exposed, and the remaining 13 feet of the shaft has been sunk in this zone. At 28 feet vertical depth, a crosscut has been extended for 22 feet on a bearing of 320 degrees into banded oxidised and decomposed schists, cutting the footwall of the lode formation which here strikes N. and S. and dips east at about 60 degrees at about 2 feet in from the shaft. From the bottom of the shaft, which is still in the lode, a crosscut extends for 20 feet on a bearing of 135 degrees, and at 14 feet in this crosscut a decided change to less oxidised but still decomposed country rock is noticeable. The minimum width of the oxidised shear zone is thus about 17 feet, and numerous small bunches and thin stringers of quartz occur in it. Free gold in a very fine state of division occurs in the decomposed lode matter along the northern wall of this crosscut, but not in sufficient quantity to be payable. A sample from the walls of this crosscut showed only a trace of gold in the dish on washing, and another sample taken from the lode matter as exposed along the south wall of the crosscut returned gold 5 grains, silver 5 grains per ton, on being assayed at the Government Chemical Laboratory. A vertical sample, taken from 2 feet in the west crosscut at 28 feet from the surface, and considered to be near the footwall side of the lode, gave gold, a trace; silver, a trace; on being assayed at the Government Chemical Laboratory.

These assay returns indicate that the portion of the lode as at present exposed are definitely unpayable. Free gold in an extremely fine state of division does occur in the lode matter, but in the present state of development of the formation no payable body of ore has been exposed.

In fairly wide bodies of lode matter such as has been shown to exist here, the values are frequently confined to relatively narrow bands, and the location of these bands or shoots is only made possible by a continuous system of assaying or panning, while development work is in progress. It is possible that the shoot of gold in this fairly large shear zone has not yet been located, and the amount of exploratory work done on it to date has not been nearly sufficient to warrant the supposition that no gold shoot exists.

The formation in which the lower portion of the shaft has been sunk, and in which the crosscut to the south-east has been cut, is a strong one structurally, and is likely to persist to some depth. It is necessary to explore the portion of it already opened up in the 38ft. shaft, along the strike, *i.e.*, north and south, by means of drives, and to crosscut east and west to the walls of the lode formation at intervals along these drives.

About 100 feet of driving and 50 feet of crosscutting from the level of the bottom of the present shaft, should determine the presence or otherwise of a shoot of gold in this formation, already known to carry a small quantity of gold.

There were no obvious geological features exposed in the workings from which the direction of a possible ore-shoot could be indicated by the writer; but it is considered that in view of the soft nature of the formation which it will be necessary to mine in exploratory work, and the undoubtedly auriferous nature of the strong structural feature constituting the lode, together with the totally inadequate amount of underground prospecting work done, that the further exploration of this formation on P.A. 1855N could be undertaken with a reasonable chance of success.

A plan of P.A. 1855N showing underground and surface exploratory work compiled from compass and tape traverses by the writer accompanies this report.*

REPORT ON PROSPECTING ACTIVITIES AT "WHITE HORSE," FIVE MILES SOUTH OF ABBOTTS MINING CENTRE, MURCHISON GOLDFIELD.

By H. A. ELLIS, B.Sc., A.O.S.M.

The White Horse gold locality is situated approximately 5 miles south of Abbots Trig. Station, and 15½ miles N. 28 deg. W. from Meekatharra in a straight line. A bush track usable by motor vehicles runs north to Abbots, and another running east by south joins the Meekatharra-Abbots road about 13 miles out from Meekatharra. There is a well equipped with windmill, tank, and troughing belonging to Youthapina Station close to the auriferous belt, and a good water supply is obtainable from this source.

The locality did not fall within the area examined in detail in connection with the geological survey of the Abbots Mining Centre, and on May 20, 1935, when the camp was being struck preparatory to returning to Perth, Prospector J. Farelly arrived and informed the writer that he had been trying unsuccessfully at intervals for several years past to locate a gold-bearing reef that had shed some very rich "floaters" at "White Horse."

*Plan not published.

Circumstances would permit of only a very hasty examination being made in an endeavour to help this prospector, and it was considered that the most useful help would be given by making an underground survey of the driving and crosscutting done on the area where the rich floaters were found. This work was carried out by Mr. R. S. Matheson on May 20, 1935, and as much of the surface geology as time would permit was also investigated and mapped. The accompanying plan embodies this information.*

It appears that for the past twenty years the presence of rich gold-bearing "floaters" has been known in the flat and gently undulating country situated about 30 chains west of the windmill and well, located on a southerly trending watercourse in this locality. Extensive costeaning and shallow surface work has been done over the area of a few acres, where the floaters have been, and still are, being found.

The surface geology of the area was not worked out in detail, but the general geology is somewhat similar to that of the Abbotts centre, consisting of bands of sheared and partially sheared, fresh looking chloritic rocks, some of which are definitely of a pyroclastic origin, between which occur wider bands of the much weathered Kyarra Schist, a schistose derivative of doleritic lavas.

The country on which the "floaters" have been found consists of Kyarra Schist, is only very slightly undulating, and is covered with a varying thickness of the usually prevalent Murchison Goldfield "cement." The prospecting operations have been confined to the band of Kyarra Schist which has a general strike of N. 20 deg. E. and a vertical dip. There is a pronounced kaolinised zone flanked on either side by yellowish weathered schist, and the various prospectors who have tried this locality have practically confined their attention to this zone. No quartz reefs have yet been discovered in this kaolinised zone, and on account of the overburden of cement, Prospector J. Farelly has sunk four shallow shafts 16, 17, 22, and 29 feet deep respectively, in and near the bleached zone, and has cut prospecting drives and crosscuts from the bottom of these shafts in an endeavour to locate the reef that has shed the "floaters." The presumption has been made that the reef still exists, and does occur in the kaolinised zone, and from the prospectors' point of view this is a good assumption. In country further north, rich but small quartz veins have been found occurring under somewhat similar conditions, and the kaolinisation of the rock at "White Horse" certainly suggests the action of mineralising solutions.

The "floaters" consist of limonitic-stained, somewhat cellular, milky white quartz with a pronounced dull greasy lustre, showing cubical and irregular masses of limonite, pseudomorphous after pyrite. Occasional small patches of unaltered iron pyrites may be seen on the freshly broken surface of some specimens, and a small staining of scorodite, the green hydrous arsenate of iron, also occasionally occurs. This latter mineral is probably associated with arsenical pyrites, and the "floaters" on which it is visible always carry a high gold content. Finely disseminated free gold is visible on some of the freshly broken porous limonite surfaces, and in the cavities from which limonite pseudomorphs have been removed by weathering. This gold is of a secondary nature, having been originally contained

*Plan not published.

in the iron pyrites, which, in the process of oxidation to limonite, has liberated its gold content now found redeposited in the limonite pseudomorphs. No free gold was seen by the writer as occurring in the quartz itself, but it is most likely that there is primary gold deposited in the solid quartz.

"Floaters" as large as a four-gallon kerosene tin are said to have been found here, and some weighing up to six pounds are still being found. On dollying and panning, specimens from the "floaters" reveal a rich gold content variously estimated at from two to ten ounces to the ton. The gold is mostly very fine with only occasional coarser grains visible in the tail.

The numerous costeans and shallow excavations cut across the area where the "floaters" occur have failed to reveal any reef that could have shed the gold-bearing quartz, and nothing in the nature of quartz reefs has been cut in any of the underground prospecting drives or crosscuts. The covering of tightly cemented alluvium—the Murchison "cement"—is variable in thickness, and the surface on which all the prospecting has been done is not perfectly level. It is possible that if an accurate one-foot contour map of the present surface were made, and used in conjunction with one constructed for the old land surface as revealed by the varying depth of cement covering, and the present distribution of the "floaters" correlated with both, then some idea of the direction from which the "floaters" were shed could be obtained.

It is possible that the reef did not occur in the kaolinised Kyarra Schist at all, but in the yellow oxidised country either east or west of this belt. The absence of obvious slopes in the nearly flat topography makes it impossible to say which side may have contained the reef, without the topographical detail mentioned above.

Another possibility must be borne in mind, and that is that the original gold-bearing quartz reef has been completely eroded away.

The gold-bearing reefs of the district are extremely lenticular both in the direction of strike and dip, and the shoots of gold are short and patchy. It is therefore conceivable that the gold-bearing reef that has shed the "floaters" was of this lenticular nature, and that the present land surface covers the root or roots of the original ore-body now represented by only very thin quartz stringers possibly only one-quarter of an inch or less in thickness.

In prospecting for similar elusive ore-bodies in flat country covered with alluvium or "cement," the practice of sinking shallow shafts and crosscutting the country at a depth calculated to keep the work just below the surface debris is to be recommended. Considerable attention should first be given to ascertaining the strike or "run" of the country, and the prospecting crosscuts should be driven as nearly as possible at right angles to this direction. A systematic lay-out for the shafts, either directly across the strike of the belt it is desired to prospect, or diagonally across it with the subsequent system of crosscuts appearing in plan as a series of steps, should be followed. It is necessary to take the shaft only a short distance into the oxidised zone, as any ore-body existing in the formation being prospected will almost always be encountered near the surface. This fact is mentioned because the prospectors engaged in

this type of work in this locality thought that they may possibly have missed the reef through not sinking their shafts deep enough.

REPORT ON JAMES, NELSON & GOODIN'S
G.M.L. 13PP—EDWARD'S FIND.

By H. A. ELLIS, B.Sc., A.O.S.M.

The owners of this lease have, in the past, been working a quartz reef which has returned good crushings from the surface to about 78 feet vertical depth, where the reef was cut off by granite in the 78ft. level.

The reef strikes 330 degrees and dips to the west at 80 degrees, being practically vertical for the upper 50 feet. It has been worked in three levels from two shafts sunk to 78 and 155 feet respectively vertical depth below the reef, situated to the east of the reef and one chain apart.

In attempting to deepen the southerly shaft to get below the granite and start another crosscut to the west, the granite was met with in the side of the shaft at 115 feet vertical depth. A crosscut was driven for 14 feet in a westerly direction on the granite surface which here dipped at 40 degrees on a bearing of N. 70 deg. E., but from plans recently compiled by the writer this crosscut was not extended far enough to cut the downward continuation of the reef in this section of the mine.

Sinking of the shaft was continued with the granite showing in the western wall as a vertical face, and at 123 feet it started to cross the north and south walls of the shaft, and at 136 feet vertical depth was right across the shaft. From here on for 23 feet, the shaft has been sunk in solid granite, and at the bottom of the shaft a crosscut has been extended into the granite for six feet in a westerly direction.

The writer, in February, 1935, when engaged in reporting on water-supply problems at Edward's Find, was invited to inspect this occurrence, and at the time the slopes of the few granite surfaces exposed indicated that the intrusion had an easterly dip, and the owners were advised to continue crosscutting to the west, a procedure they had already commenced at that time. This crosscut has not been extended beyond six feet, the hardness of the granite having deterred the effort to pierce it in this direction.

The position now is much the same as it was in February of this year, and assistance from the Mines Department has been requested to enable the owners to pierce the granite.

They state that their requirements are an air compressor, jack-hammer, and air-pipe and hose with necessary power unit to be provided by the Mines Department on loan, the plant to be returned to the Mines Department or possibly purchased if the reef is found and proves to be payable. They do not seem to be interested in £ for £ subsidy.

A detailed examination of this mine was made by the writer on July 29 and 30, 1935, and a plan of the underground workings, together with longitudinal and vertical cross-sections have been compiled.

The granite intrusion has been found to have an uneven upper surface, but no indication of its total thickness in any part can be ascertained, only the upper surface having as yet been exposed in isolated places in the mine. From calculations based on the measured depth of these isolated surfaces below the collar of the 78ft. shaft, and assuming that the granite is in the form of a dyke, the upper surface is calculated to have a general dip of 63 degrees on a bearing of N. 55 deg. E. (magnetic).

Assuming that the lower surface is parallel to the upper surface, the shortest way out of the granite from the bottom of the 155ft. shaft is by sinking an inclined shaft at a depressed angle of 27 degrees from the horizontal on a bearing of 235 degrees (magnetic). This would take the workings towards the downward continuation of the reef if it persisted beyond the granite.

The granite has invaded the reef and partially replaced it in the 78ft. level, but there is no indication as to whether or not the granite has been intruded along a fault plane. The reef should persist underneath the granite if not displaced by faulting, and values should not be affected. The problem is to determine the thickness of the granite dyke.

In a reef about 20 chains west in Edward's G.M.L. 11, a granite dyke cut the main reef without either displacing it laterally or affecting values, but this dyke was very thin. In the writer's opinion it is first advisable to determine the thickness of the dyke by cutting a crosscut inclined at a depressed angle of 27 degrees to the horizontal on a bearing of 235 degrees (magnetic) from the bottom of the 155ft. shaft.

Such a crosscut would extend in the direction of the downward continuation of the reef, and if the dyke had been intruded along a fault plane, dipping north-east and the reef had been faulted, as is possible, the crosscut would have a chance of eventually cutting the reef.

In any case, once the thickness of the dyke is determined, the advisability of sinking the main shaft could be considered with the object of crosscutting at a greater depth to intersect the reef.

The values persisted down to the point where the reef was cut off by the granite, and the stope length of the shoot was 20 feet in No. 1 level (34ft. level), 120 feet in No. 2 level (54ft. level), and 170 feet in No. 3 level (78ft. level), with 35 feet of stope length 20 feet deep underfoot in the north end of No. 3 level down to the granite. The average width of the reef where stoped was about 15 inches, and the following crushing returns from ore mined from this reef were supplied by the owners and are believed to be correct:—

Tons of Ore Treated.	Gold therefrom. ozs.	Gold in Sands.
63	163	5 dwt. 12 grains
133	174	6 dwt. 15 grains
55	48	8 dwt. 1 grain
155	128	7 dwt.
120	88	
Total 526 tons	601 ounces	

The gold was of a particularly high grade, being stated by the owners to be sometimes higher than standard. From the above figures the average grade of ore treated was 23 dwt. per ton, disregarding the gold left in the sands.

Since ceasing work in this mine sometime last February, a second line of reef about 5 chains west of the one under discussion has been discovered, and a rich shoot of gold of about 10 feet stope length has been followed down for about 70 feet from the surface, at which depth it has been cut off by a flatly dipping fault.

A third line further west is now being prospected from a shallow shaft and a gold-bearing quartz reef is being opened up, though values in this reef are still low.

Summarising the situation it will be seen that:—

(1) A highly payable gold reef of an average width of 15 inches where stoped, striking N. 30 deg. W. and dipping steeply to the west has been cut off by presumably a granite dyke at a depth of about 78 feet, the stope length of the gold shoot immediately above the granite being 170 feet.

(2) In an endeavour to get through the granite intrusion by sinking the main shaft and crosseutting, the owners sank the shaft 23 feet in solid granite and crosseut 6 feet west without getting out of it.

(3) The owners now require assistance from the Mines Department in the form of a loan of plant consisting of air-compressor, power unit, jack-hammer and air-lines to be problematically ultimately purchased or the hire paid for, to enable the solid granite to be penetrated in the search for the reef below the intrusion.

(4) Six hundred and one ounces of practically standard gold have been won from the mine from 526 tons of ore treated.

(5) Only the top surface of the intrusion has been exposed in isolated places in the workings, and no conception of its thickness can be obtained in the present mine workings.

CONCLUSIONS.

(a) The granite is probably in the form of a large dyke intruded along a fault plane.

(b) The calculated dip of the upper surface is about 63 degrees in a direction N. 55 deg. E. (magnetic), and assuming the lower surface to be parallel to the upper surface, the shortest way out of the granite is by means of a crosseut (or inclined shaft) extended on a bearing of 235 degrees (magnetic) at a downward inclination of 27 degrees to the horizontal from the bottom of the 155ft. shaft.

(c) The search for the reef below the granite is likely to be a hazardous undertaking, as faulting may also be present, and such granitic intrusions have characteristically uneven boundaries.

(d) The possibility of the intrusion being very large and its liability to alter its attitude must be borne in mind.

RECOMMENDATIONS.

As a prospecting venture, the inclined crosseut suggested from the bottom of the 155ft. shaft could be cut with a chance of ultimately cutting the reef below the granite, if the latter does not prove to be excessively thick.

The fact that good crushings were obtained from this reef before it was lost, and from another parallel reef subsequent to that event should be considered when the question of granting assistance to the present owners is under discussion.

PROGRESS REPORT ON THE GEOLOGY AND MINES OF THE YILGARN GOLDFIELD (South of the Great Eastern Railway).

By H. A. ELLIS, B.Sc., A.O.S.M.

INTRODUCTION.

The major part of the southern portion of the Yilgarn Goldfield and its associated accessible mines were geologically surveyed in the years 1912-1913 by Messrs. T. Blatchford and E. St. Smith; by far the greater portion of the work being done by the former. The results of this survey were co-ordinated by Mr. Blatchford and published as Bulletin No. 63 of the Geological Survey of Western Australia's geological series in 1915.

Renewed activity in the Yilgarn field led to a demand for this bulletin which could not be met, and with the object of bringing the geological and mining information up to date for incorporation in a new issue, the writer was instructed to carry out a re-survey of the whole of the southern portion of the Yilgarn Goldfield.

FIELD WORK.

Field work was commenced by the writer and Messrs. R. S. Matheson and R. A. Hobson towards the end of July, 1935, and was continued to mid-December, when the party was withdrawn to head office in order to do the essential office and laboratory work connected with the survey. Field work will be resumed early in 1936.

During the 1935 field season the various G.M.Ls. embodied in the following groups have been investigated by Messrs. Matheson and Hobson:—Jaceoletti, Glendower, Lennebergs, Burbidge (including with this latter group the Great Victoria, Grand National, Prince George and M.O.M. leases), Marvel Loch, Xantippe, Donovan's Find and Edward's Find.

The general geology of the area was undertaken by the writer, who is also responsible for the interpretation of the mining geology of the groups investigated by his two colleagues.

The general structural geology of the auriferous belt south from Southern Cross to Parker's Range and including the Yellowdine-Palmer's Find belt, has been studied in as great detail as the very poor exposures permit, and in subsequent paragraphs statements concerning this structure must be regarded as tentative only, being subject to modification by the results of areal mapping yet to be done.

MAPS.

The mapping of the geological structure of the southern portion of the Yilgarn Goldfield presents a very formidable task on account of the low relief, dense forest and thick scrub, paucity of outcrops and an ever persistent mantle of sandy soil and laterite. To complicate this feature further, it has been found that the gold-bearing formations are almost entirely of a sedimentary nature, and that if

a true picture of the structure is to be obtained, then the shape of every inferred geological boundary must be assumed to be reasonably correct when the maps are undergoing structural interpretation.

It therefore becomes evident that unless these sedimentary boundaries can be delineated with a fairly high degree of accuracy, then the geological structure cannot be unravelled. If most of the geological boundaries could be shown to be governed by the principles of transgressive igneous intrusion, then the question of boundary shapes would not assume such importance.

Continuity of outcrop for more than a few chains is extremely rare in this field, and all the inferences to be made from a study of the soil, vegetation and topography have had to be used in conjunction with the observations on actual outcrops in the compilation of the maps.

In mapping the gold mining leases, they have been taken in groups whenever possible, and mostly fall on our plane-table sheets which measure 18in. x 24in., plotted to a scale of five chains to one inch, one sheet to the group.

The actual surveying has been done with a plane table, using a telescopic alidade and staff for the tachometric measurement of distances, while all the other known methods of plane-table surveying have also been freely used in the location of points such as lease corner-pegs, shafts, surface workings, outcrops and geological boundaries. Recourse has been had to prismatic compass and chain surveys in country too thickly timbered to permit of the use of the plane table, while compass and paced traverses have been avoided. The lease plans can therefore be regarded as conforming to a standard of accuracy well within the plotting limits of the scale used.

For each group of leases, two 18in. x 24in. plans have been prepared. One is a "fact" or surface map showing topographic features, the positions of shafts, costeaus, open cuts, buildings, lease boundaries and outcrops, together with geological boundaries where these can be defined with certainty. Soil covered areas are shown as such, and the distribution and nature of the vegetation is also indicated. It is hoped that this map will effectively serve the purpose of enabling a true geological picture of the surface exposures to be gained at a glance.

The other group map is a sub-surface map showing the nature of the rock underlying the mantle of soil, and has been compiled from information obtained from underground workings, surface outcrops and inferences of the existence of certain rock types, gained from a fairly sure diagnosis only of the soil type overlying this inferred rock. On it are also shown the positions of ore bodies.

There is scope for disagreement on the position of geological boundaries in this map which does not exist in the "fact" map, but it was thought advisable to take this step of producing a sub-surface map in order to indicate what we believe to be the solid geology of otherwise soil covered areas. We do not believe we are correct in every instance, but submit our interpretation in the hope that our work will form a basis for any future investigation.

MINE PLANS.

When procurable, copies of mine plans have been obtained from mine owners, and tracings have been made and used in underground examinations. Any underground workings of even small extent have been surveyed with prismatic compass and tape, and plans and sections on a scale of 50 feet to the inch have been prepared.

The underground geology of all producing leases and prospecting areas has been investigated and incorporated in the mine plans, which therefore form an accurate record of mine workings as well as the geology of each individual producer.

GENERAL GEOLOGICAL MAP.

The general geology has been recorded on Lands and Mines Department lithographs on scales of 300, 80 and 40 chains to the inch, but finality with respect to geological boundaries has not been reached on that portion already investigated, it having been found necessary to possess a more complete knowledge of the structure before boundaries can be reasonably inferred over large featureless sand and soil covered areas.

A considerable volume of structural data has been accumulated, and specimens of all rock types encountered have been collected and recorded on our field sheets.

GENERAL GEOLOGY.

Throughout the progress of the survey, the principal object aimed at has been to endeavour to find out why the gold is where it is, to correlate the known occurrences of gold ore with the geological structure, and to search for similar structures in areas not yet known to be auriferous.

As a result of investigations so far, no practical results have come from this endeavour, due mainly to the inability to work out correctly detailed structure owing to the paucity of outcrops and the shallow depths of the mine workings.

We have been forced to the conclusion that the original conception of the greenstones as being igneous masses intruded into a series of sediments (The Yilgarn Series) is untenable, in the light of field evidence at present at our disposal.

So far, no evidence at all in support of the intrusive nature of any of the so-called "greenstones" has been found, but a considerable body of field evidence has been collected which supports the conception that the hard, dark, green, grey and black crystalline rocks of the South Yilgarn Goldfield are lava flows, sub-aqueous tuffs, and thin and thick banded basic sediments forming part of a series conformable with the grey shales, grits, quartzites, mica schists, etc., of the Yilgarn Series which probably underlie them.

The indications are at present that the lavas occur towards the base of the basic series, and are succeeded by beds of sub-aqueous tuff, and normal water deposited basic sediments with numerous bands of acid sediments of varying thickness consisting of shales, quartzites, graphitic schists, etc.

The whole of the original "greenstone" areas of Bulletin 63 can be shown to consist largely of interbedded basic and acid sediments with the former predominating, and with a relatively small development of basic igneous rock as metamorphosed lava flows, occasionally showing pillow structure.

In the acid sediments themselves, numerous thin bands of basic sediments occur, and are so frequent in places as to necessitate their being mapped as "acid sediments with basic bands."

Practically the whole of the rocks investigated with the exception of the intrusive granite and lava are of shallow water origin, the rapid alternation of beds of different material and different grain size testifying to this.

It appears to the writer that the Yilgarn Series of recognised metamorphic rocks, together with the conformable so-called intrusive "greenstones" of Bulletin 63, now regarded as of predominantly sedimentary origin, constitute an horizon in a previously thick series of sediments, the basal and upper members of which may have been composed of grits.

This series of sediments and associated volcanic and pyroclastic rocks laid down under water in a great syncline were involved in mountain building orogenic movements, and were subjected to the processes resultant from the intrusion of a granitic magma on a large scale. Large areas were engulfed by the granite and equally large areas were converted into paragneisses and generally granitised. During the mountain making folding, these sediments were folded into major antiforms and synclines with steep northerly and southerly pitching axes and underwent regional metamorphism.

Some evidence for the existence of flat thrust faulting on a moderately small scale has been found to the south of Palmer's Find, and it is not unlikely that this structural feature has played an important part in the present distribution of auriferous belts. A second period of folding, the axes of which trend generally N.W. and S.E. and are more or less horizontal, has been imposed on these rocks. The folding during both of these periods has been intense, and close tight folds have been formed which have frequently ruptured under the great folding stresses and have produced shear zones in which many of the known auriferous deposits have been found to occur.

Still another period of folding, the axes of which have a general east-west trend, has been imposed upon this series of rocks, and the bearing that this folding has had on gold deposition may prove to be of some importance when further investigations have been made in the Great Victoria-Nevoria district.

From a knowledge of the geological structure already gained, it can be stated with some confidence that lateral prospecting from the mine workings in known auriferous areas is likely to lead to the discovery of further gold-bearing formations. It can also be stated that the continuation of a known fairly straight portion of lode need not necessarily be found in a straight line on either end of this formation, but may be found to either side, since the shape of the ore deposits is almost everywhere controlled by folding.

Brief reference to the nature and occurrence of granite and sand-plain areas will be fitting at this juncture, in view of the fact that the writer's conception of these, as in the case of the so-called "greenstones," is not in accord with previous conceptions as published in the publications of the Geological Survey of Western Australia. So far, in the course of the survey, several "granite" rocks have been investigated, and it has always been assumed in the

past that the bare rock masses which outcropped from beneath the sandplain were composed of granite, and represented monadnocks, the remnants of a previous cycle of erosion.

The sandplain country has also been assumed to overlie granitic areas, and while this is undoubtedly partially true, the nature of the rock underlying these sandy scrub-covered wastes is not considered by the writer to be entirely granitic, but in all probability consists largely of gneiss, representing the metamorphosed equivalent of a once thick and extensive series of felspathic grits, of which the Yilgarn Series with its associated basic sediments, pyroclastic rocks and lavas forms an horizon.

The true granite rocks are massive biotite granite devoid of pegmatite dykes, and appear to represent the apices of granitic intrusions. Other rocks present a distinctly gneissic structure, are seamed with intersecting pegmatite dykes, and in places produce all the characteristics of migmatites. A typical example of such a structure is to be found in the large rock situated about half a mile east from a point five miles north of Palmer's Find on the Palmer's Find-Yellowdine Siding road. It thus becomes evident that all the "granite rocks" are not true granite as was at first thought, when it was conceived that the sandplain country covered gneissic areas as well as granitic terrains.

It is possible that the main granitic intrusion was post folding, and it is established from underground inspection of numerous mines that granitic and pegmatite dykes have cut the known auriferous formations in a frequently flatly lying intrusive manner.

Assuming the origin of the gold in the lodes and reefs to have been genetically associated with a granite magma, then at least two periods of granitic intrusion are so far indicated.

Concerning the auriferous belts and their association with the dark ferro-magnesian basic sediments, pyroclastics and basic lavas and their associated fine-grained acid sediments, it seems probable that this series of predominantly stratified rocks has constituted a general incompetent series, the numerous members of which themselves show relative incompetency. Their associated beds, the coarse felspathic grits which have been assumed to overlie and underlie this series, are considered to have been the major competent beds, and the nature of their original constitution has rendered them readily amenable to regional metamorphism.

We therefore see in the so-called "greenstones" evidence of intense folding, and in that portion of the area so far examined, the narrow belt of basic and acid sediments and lavas extending south from a little east of Yellowdine Siding through Palmer's Find to Meier's Find affords ample field evidence of the severe nature of this folding.

RESULTS OF THE RE-SURVEY.

1. Of major importance to the distribution of possible auriferous formations has been the discovery during this survey that the occurrence of the known ore bodies has not been, as previously considered, dependent upon the contacts of intrusive greenstone bodies and the intruded sediments.

2. It has been found that the whole of the gold belt so far investigated consists of a series of sediments of both a basic and acid nature, pyroclastic rocks and lava flows, all interbedded in a fairly rapidly alternating manner and that the formation of the gold-bearing deposits has been controlled primarily by the principles of intense folding.

The gold-bearing solutions have penetrated shear zones in both types of rocks, both basic and acid, and have not infrequently chosen narrow quartzite bands interbedded with thick basic sediments.

3. On account of the bedded sedimentary nature of the rocks and the intense folding they have undergone, it can be reasonably inferred that lateral prospecting from mine workings is already known gold-bearing formations is likely to lead to profitable results.

4. There is a great area of possible gold-bearing country covered with recent superficial deposits, and though this type of country is admittedly very difficult to prospect, the chances of ore bodies existing in it should not be overlooked.

5. By far the greater quantity of gold-bearing material in the South Yilgarn Goldfield is contained in lode formations as distinct from quartz reefs, the tenor of the latter being almost always higher than that of the former.

While these lode formations are structurally strong in the majority of cases, it is unfortunately true that their gold content is low. No lode formations have as yet been investigated below the oxidised zone in the South Yilgarn field, but in view of the fact that practically all the worked out and working mines in these formations show only low-grade secondary enrichment, little hope can be given for payable primary deposits in the unoxidised zone.

6. The need for the very thorough underground prospecting of any low-grade formation before the erection of a treatment plant on it is emphasised by the extremely erratic nature of the secondary enrichment, and care must be taken not to place too much reliance on anything but a very thorough systematic sampling of any low grade ore-body which it is intended to treat.

7. The auriferous quartz reefs so far seen have been frequently found to be lenticular in nature both along the strike and down the dip, and though usually carrying a higher gold value per ton than the lode matter, have not the continuity to enable them to be large producers.

8. A fairly thorough stocktaking of the mineral resources in the area so far investigated has been effected, and it has been found that this in itself will prove invaluable to future seekers of gold in the southern portion of the Yilgarn Goldfield.

9. Whilst engaged on the field work we have been called upon for advice on numerous occasions by many small mine owners and prospectors, and have frequently directed the search for the continuation of faulted ore-bodies and underground prospecting in general.

SUMMARY OF PETROLEUM EXPLORATION IN WESTERN AUSTRALIA to JANUARY, 1935.

By R. A. HOBSON, B.Sc. (Hons.).

1.—INTRODUCTION.

Prior to 1919 no acceptable evidence of mineral oil had been forthcoming from anywhere in the State. Bitumen had been recorded as being washed up on the western portion of the southern coast, and oil reported on the Princess Royal Harbour, Albany. Supposed prospective areas were examined by Maitland (1902, 1904, 1906), Montgomery (1903) and Woodward (1915). These examinations failed to disclose any favourable conditions for the formation and retention of oil. It was shown that the bitumen was found only on the beach and not inland, and that it was distributed over a considerable length of the south coast of Australia. It was not considered an indication of the presence of mineral oil inland. Any oil in Princess Royal Harbour, Albany, was considered to have been derived from shipping. Maitland (1906) further found other conditions unfavourable.

The general position was reviewed by Maitland (1913), who showed that no evidence had been forthcoming at that date of the existence of mineral oil anywhere in the State.

In 1917 attention was drawn to the Nullabor Plains. The geology of this area was reviewed by Maitland (1918), whose work is summarised in a later section of this report. He evidently formed an unfavourable opinion of the area.

In 1919 Harry Price, a well-sinker, reported (Blatchford, 1927) that he had recognised traces of oil in a bore being sunk in search of water on Gogo Station, Kimberley Division. The bore was located on the west side of a southern extension of the Rough Range. About the same time Walter Okes reported the finding of glance pitch close to the junction of the Ord and Negri Rivers. Both these discoveries were confirmed by Blatchford (1921) and descriptions published. Thus attention was drawn to the Kimberley Division and geological work followed immediately.

2.—SCOPE OF REPORT.

An attempt has been made to summarise the work of various geologists in various districts. Only reports relating to petroleum exploration have been examined. A brief resumé of the geology of each area as found in the various reports is given and also the conclusions arrived at by the various authors. No attempt has been made to give a complete summary of the geological knowledge of the various districts. Accompanying this report is a map* which is to be used in conjunction with a geological map of this State. The map shows the areas of the State covered by sedimentary rock of Palaeozoic or younger age, and areas whose oil prospects have been considered. In some instances the map shows the area covered by plates or maps accompanying reports and in others the area reported upon. This latter is usually an oil prospecting lease. The report is also accompanied by an Appendix and Bibliography.

3.—SEDIMENTARY AREAS IN W.A.

Four main Artesian basins are recognised in Western Australia:—The Desert Basin, the North-West Basin, the Coastal Basin, the Eucla Basin, together

* Map not published.

with two smaller ones in the East Kimberley. Other smaller areas of sediments exist *e.g.*, the Upper Fortescue River Area (Cainozoic), the Collie Coal Basin (Permo-Carboniferous), and an area of Permo-Carboniferous rocks in the south-west corner of the State. These latter however are not important when considering the oil prospects of the State.

The four main Artesian basins mentioned above, cover most of the area of sediments shown on the accompanying map.*

4.—GEOLOGICAL SURVEYS AND REPORTS IN CONNECTION WITH PETROLEUM IN WESTERN AUSTRALIA.

These are best considered according to the various districts in which they have been carried out. They will be discussed under the following heads:

I. Kimberley Division.

- i. The Desert Artesian Basin.
 - (a) Fitzroy Valley Area.
 - (b) Southern portion of the Basin.
- ii. The Ord River Area.

II. The N.W. Division (of which the N.W. Artesian Basin is part).

- i. The Northern or Exmouth Gulf Area. O.P.A. 258H.
- ii. The Southern Areas.
 - (a) Wooramel River Area.
 - (b) O.P.A. 191H.
 - (c) O.P.As. 231H, 235H, 236H.

III. The S.W. Division (of which the Coastal Artesian Basin is part).

IV. The Eucla Division (of which the Eucla Basin is part).

I.—KIMBERLEY DIVISION.

Following Blatchford's confirmation of Okes' and Price's reports, geological work was immediately undertaken by Blatchford in the Fitzroy valley area and by Mahoney in the Ord River area. This was the first geological work undertaken in this district having as its special object the consideration of the district's oil possibilities. Blatchford (1927) has summarised the results obtained in 1926 and noted the work of previous geologists in the Kimberley District in G.S.W.A. Bulletin 93.

i.—The Desert Artesian Basin.

(a).—Fitzroy Valley Area.

Blatchford, T., 1927, G.S.W.A. Bull. 93.

The object of this Bulletin as set out in the introduction is to collect together the work of Blatchford and Talbot in the Fitzroy Basin, and to discuss the oil prospects of that area. Reference is also made to the country between the Fitzroy and Ord Rivers and about the latter. The work in the Fitzroy valley was commenced by Blatchford, Talbot and Rowe in 1922 and completed by Talbot in 1923.

Most of the area was found to consist of rock of Carboniferous age. Two series were recognised—the lower limestone series and the upper sandstone series. The bore at Price's Creek, from which the showings of oil had been obtained, was in an area of lower limestone rocks. The following geological sequence was recognised for the Kimberley Division:

Recent.—Surface deposits covering the plains.
Brown or black river alluvium. Low-lying sandy ridges, known as *Pindan*.

* Map not published.

Pliocene(?)—Partly consolidated ferruginous sandstones, grits, conglomerates.

Tertiary(?)—Leucite bearing lava rocks. These are certainly Post Carboniferous and may be Tertiary by comparison with similar rocks of Sumatra, etc.

Jurassic.—Occur as a strip along the west coast from Swan point to Wallal and contain Artesian water at Broome. The eastern boundary of the geological map is tentative.

Carboniferous.

Upper Sandstone Series.

- i. Ferruginous sandstone, grits, with occasional conglomerate beds.
- ii. Flaggy sandstone and shales. Occasional narrow limestone beds.
- iii. Grits, sandstones and shales.
- iv. Massive sandstone with glacial beds.
- v. Narrow limestone bed.
- vi. Well bedded sandstone with occasional thin bands of shale.

Unconformity.

Lower Limestone Series.

Grey to white limestones usually massive but sometimes bedded.

Devonian.—Impure reddish limestones at Mt. Pierre. Also base of Napier Range.

Cambrian.—

Upper Cambrian:

Chocolate coloured sandstone.
Fossiliferous limestones.
Mudstone, various coloured limestone and shales—Fossiliferous.
Massive unfossiliferous limestone.
Basalt lava flows.

Unconformity.

Lower Cambrian:

Quartzites.
Dark coloured shale.
Limestone—may be absent.
Quartzite.
Limestone—thin.
Quartzite.

From observations in Ord River Valley. Refer to sections Plate VII., G.S.W.A. Bull. 93.

Unconformity.

Pre-Cambrian.—

Nullagine beds of the Northern Plateau.
Quartzite, shales, limestones, etc.

Unconformity.

Metamorphics with intrusive granites and basic rocks.

Structures considered to be suitable for the retention of mineral oil were recognised at Mt. Wynne, Grant Range, and Poole Range. Each of these is described in detail.

Other conditions for the existence of mineral oil were thought to be favourable but some doubt was expressed as to the existence of suitable cover rock.

As a result of the first portion of the geological work drilling was commenced at Mt. Wynne. The other structures had not been found at that stage. Showings of bitumen and oil were obtained and these will be more fully dealt with in Section 5 of this report.

In the main portion of the report no site is selected for further drilling.

Appendix II. deals with the selection of a drilling site at Poole Range, following a visit of inspection by Dr. Wade, and is best discussed after Dr. Wade's work has been recorded.

Wade, A., 1923-24. *Report to Commonwealth Government.*

During 1923-24 Wade visited various areas in Australia on behalf of the Commonwealth Government. Amongst these was the Kimberley Division in Western Australia. During this work he was accompanied by Blatchford, Talbot (in the Fitzroy Valley), and others. The structures previously referred to—at Mt. Wynne, Grant Range, and at Poole Range—were visited. The Rough Range was also examined. Dr. Wade considered that for the Fitzroy Area, any oil present would have had its origin in a series below the Permo Carboniferous Series, and that most probably this series would be of Cambrian age. He was unable to satisfy himself that there were any strata in the Permo Carboniferous in which oil could have originated. Small showings at Price's Creek in the lower carboniferous limestone are discounted as are also the showings in the bore at Mt. Wynne. He also felt some doubt as to the existence of suitable cover rocks. As a test of the petroleum possibilities of the area, he suggested three wells, two at Price's Creek and another elsewhere, preferably at the Poole Range.

Blatchford, T., *G.S.W.A. Bull.* 93—*Appendix II.*

Following Wade's recommendation Blatchford was instructed to select a drilling site at the Poole Range. This had been located by Talbot, Geologist to the Freney Kimberley Oil Co., and a map had been prepared by him. Poole Range was found to be a collapsed anticline with its longer axis in a N.N.W.-S.S.E. direction. A noticeable feature of the area was the eight faults all striking parallel to the longer axis of the fold. It was thought that any oil migrating would have come from the S.W., and a site was therefore chosen on the west side of the anticline, west of the most westerly fault.

Clapp, F. G. (1925-26). *Articles published in various journals—(See Bibliography).*

During 1924 Clapp made a reconnaissance trip through various portions of W.A. During this trip he examined portions of the Desert Basin and reported unfavourably on the oil prospects of that area. In his summary he says: "The insignificant nature of the oil indications in the several wells drilled, the apparent total absence of natural gas, uncertainty as to the actual existence of any surface indications, lack of shale cover, intense faulting and possible metamorphism of the marginal parts, prohibitive thickness of sandstone throughout enormous areas and somewhat unsatisfactory source of origin, are collectively considered unfavourable to the commercial occurrence of oil in the Desert Basin."

Forman, F. G., 1929. *G.S.W.A. Ann. Rept.*

Forman briefly summarises the geology of the Desert Basin and discusses the oil possibilities. A more optimistic note is sounded in this report. As a result of information from the bores it was considered that sufficient shaly strata were present to provide adequate cover rock. Forman points out the location of all the known structures around the edge of the Fitzroy basin and the resemblance of this arrangement to that occurring in the producing areas of U.S.A. It is suggested that further structures may be found on the southern and eastern boundaries of the Desert Basin.

Wade, A., 1935. *Interim Report to Freney Kimberley Oil Co. (O.P.As. 146H, 186H.)*

The two O.P.As. held by the Freney Kimberley Oil Co. cover an area of 94,400 square miles of the Kimberley Division. The area is bounded on the north by 16th parallel of south latitude, on the east by the Western Australia-Northern Territory State boundary, on the south by 19° 30' parallel of south latitude, and on the west by the 123rd meridian of east longitude. It is shown on the accompanying map.* Dr. Wade points out that only portion of this is potential oil country. There is a large V-shaped area mainly of rock of the Nullagine Series (Pre-Cambrian), with smaller areas of metamorphic and intrusive igneous rocks. It is the S.W. portion of the O.P.As. which has been examined by Wade. Wade points out that the report is an interim report and as such is subject to revision as the work proceeds. In all, 10,000 square miles were examined by Wade and his assistants. Various types of work were done from reconnaissance to detailed work. The area examined and the type of work done on each is clearly set out in Section 2 of the report. A summary is given of the geological sequence arrived at and a copy of his table is attached. The sequence ranges from Pre-Cambrian to Recent, but it is to the Permo-Carboniferous that Wade attaches importance from the point of view of oil. He finds that there are considerable thicknesses of argillaceous strata, which is important, as early geological work had shown this to be doubtful. He proposed seven unconformities, three of which occur in the Permo-Carboniferous. As a result of his work, Wade considers that the lower beds of the Permo-Carboniferous Series have been too disturbed—folding has been too intense and faulting too prevalent—to make it probable that they would contain commercial supplies of oil at the present time. The presence of unconformities has also increased the chance of leakage of any oil which may have been formed. It is considered that the Permo-Carboniferous beds above the glacial series are the most likely beds to contain commercial supplies of oil. He recommends that the work be continued during the present year, and that search be made for areas with a low degree of folding in the upper Permo-Carboniferous beds.

(b).—From Southern Portion of Desert Basin.

Areas 21H, 23H, 25H.

These areas were visited by Leo. J. Jones, who made a reconnaissance survey over a large area. They occur in the Eastern Division of W.A., but may be discussed here since geologically they are continuous with the Fitzroy Valley area. The report on O.P.A. 25H is not available at the time of writing, but this

* Map not published.

area is shown on a map, together with O.P.A. 21H. Also the map accompanying the report on O.P.A. 23H is not available. He recognised the following geological sequence:—

Pleistocene to Recent.—Soil, sand, travertine, chalcedony, gypsum, ferruginous and saline deposits.

Carboniferous.—Upper Sandstone Series. Lower Limestone Series.

Cambrian.—Nullagine beds. Lower Limestone Series.

Pre-Cambrian.—Metamorphic Series.

Archaean.—Granite and Gneiss.

Referring to the Nullagine, Jones says: "My observations along Christmas Creek, north of your company's block, revealed what appeared to me to be an extension of these (Nullagine—R.A.H.) beds resting conformably on a limestone series, containing *Salterella Hardmani*, an undoubted Cambrian form, and hence my provisional classification as Upper Cambrian for these beds." Jones would seem to be in error here, as the Nullagine beds are now considered to be of Pre-Cambrian age (Geological Map of W.A., 1933). He records that the Carboniferous Sandstone Series "are for the most part nearly horizontal, the normal dip rarely exceeding two degrees. In places, however, local gentle warping or folding has taken place and dips up to 27 degrees are recorded." The above is written with reference to 21H. For 23H, dips rarely exceed 5 degrees. The following fossils were found in a range of hills N.E. of No. 27 Well on the Canning Stock Route:—

Productus subquadratus.

do. core.

Spirifera byroensis.

Spirifera sp. nov.

Orthothetes sp.

Nautilus coelonautilus.

From the lower Limestone Series, he records the following fossils:—

Chonetes pratti.

Dielasma hastati.

Productus sp.

The abundance of fossils in the lower Limestone Series is noted and this series is considered to be the most likely source of petroleum.

No surface indications of petroleum were found.

Two test holes were recommended:—

- (i) Near to Godfrey's Tank on a "well defined dome."
- (2) About 2 miles west of No. 50 Well, Canning Stock Route, on a "structural terrace."

No drilling has been undertaken in this area.

The geology of the Canning Stock Route, the northern portion of which crosses the area covered by Jones, was first described by H. W. B. Talbot (1910). Talbot recognised the existence of a large area of carboniferous rocks.

ii.—Ord River Area.

Following the confirmation of Okes' discovery of bitumen close to the junction of the Ord and Negri Rivers, a geological survey of this area was under-

taken by Mahoney (1922). He was able to recognise the following geological sequence (the younger beds are placed first):—

Mt. Elder Sandstone Series.—Coarse-grained sandstones. May be silicified. False bedding.

Negri Series.—Limestone, mudstone and shales. No trace of metamorphism. Limestone fossiliferous. Series would provide impervious "cover" rocks.

Basalt.

Hard grits and conglomerates.

Mahoney considered that the bitumen found in the basalt at Okes' find had been derived from the limestone of the Negri Series. Blatchford (1921), after his first examination, considered that this bitumen had been derived from the series underlying the basalt. Mahoney was later supported by Wade. Further reference will be made to this later.

Mahoney chose a site for the first trial bore some 16 miles south-easterly from Okes' find, on an anticline having a north-west trend. It was said to have a pitch to the north but there is no indication of closure to the south. This site is shown on the map which accompanies this report.*

Fossils identified by Chapman (1922) indicated an Upper Cambrian age for the Negri limestone.

Wade's visit of inspection (1923-24) in the Fitzroy Valley area has already been noted. On the completion of this he crossed to the Ord River area, making an examination of the country on the way. Two sections accompany Wade's (1923-24) report, and show the geological succession and structure indicated by his traverses. Wade found that the upper portion of the Ord River flows through an area of Upper Cambrian rock, underlain by basalt. These Upper Cambrian rocks are composed of fossiliferous limestones, green and white shales, flaggy mudstones with a massive cherty limestone immediately above the basalt. The Upper Cambrian strata contain well preserved fossils and have a very fresh and young appearance. Wade says "it was hard to realise that we were dealing with one of the oldest series of fossiliferous strata." The basalt is vesicular and is considered to be a flow, not a sill. Underlying the basalt are a series of quartzites, indurated shales, fine grained siliceous flags, with a basal bed some 400 feet thick of a hard massive quartzite.

Soft red, white and yellow sandstone which may be carboniferous, but which contain no fossils, occur at Glass Hill and Mt. Buchanan and other places on the west side of the river. On the east side of the Ord chocolate coloured grits, flags and well bedded sandstone occur in the Mt. Elder Ra. These are apparently conformable with the Upper Cambrian strata, but Dr. Wade thinks that more detailed mapping may show an unconformity. Above these in the Mt. Elder Ra. grey, green and white cherts occur at Trig. J40. These contain *Planorbis hardmanni*, which is a tertiary fresh-water fossil. These occur about 1,000 feet above sea level.

Wade agrees with Mahoney that the bitumen found in the basalt has come from the limestone above, and considers that any oil originally present would have escaped along the junction of the limestone and the basalt. He considers that there is no chance of oil being present in commercial quantities.

* Map not published.

Blatchford (1927) makes reference to the Ord River Area. He recognises the existence of an unconformity between the basalt and the Lower Cambrian beds. No further drilling is recommended. He believes that the bitumen found in the basalt has been derived from the underlying beds, and has reached its present position by way of fractures, etc., through the basalt.

The arguments advanced by various writers may be summarised as follows:

Derivation from overlying limestone.

For:

- (1) Bitumen is found at junction of limestone and basalt.
- (2) Beds of Upper Cambrian Series are impervious and any oil formed in lower portion of these would tend to escape at the junction with the basalt.
- (3) Upper beds are less altered than lower Cambrian beds. Rich in fossils and suitable for formation of oil.

Against:

- (1) Bitumen is not found in overlying limestone or sandstone.
- (2) No bitumen or oil in Okes-Durack bore which penetrated these to basalt.

Derivation from underlying series.

For:

- (1) Both places where the bitumen is found is on a line of weakness. Only occurs where rock is fractured.
- (2) Hot spring at Texas Homestead probably comes from below the basalt, suggesting sufficient permeability for fluids to travel.
- (3) The occurrence suggests that the bitumen has been injected into the basalt under pressure. If travelling along junction of limestone and basalt why is it not injected into the limestone above.
- (4) Basalt is sheared and bitumen injected after shearing.
- (5) Bitumen reported in Northern Territory in rock corresponding to lower group in the Ord.

Against:

- (1) Basalt taken as a whole is very compact and impervious, also very thick.
- (2) Any oil occurring in the lower series would tend to leak at the junction of these with the basalt or through some outcropping edge of the lower beds.
- (3) Lower beds consist of quartzites, indurated shales, etc., which have been considerably metamorphosed. Also tilted and faulted in Osmond and Albert-Edward Ranges. No evidence of any bitumen occurring in the ranges due to leakage.
- (4) Beds at least lower Cambrian in age and may be older.

Referring to the Ord River Area Wade (1923-24) says: "We believe that the oil originated in the Upper Cambrian strata and that at some age, long past, oil field conditions may have prevailed in the

Ord Area, but the oil has gone and only the residual bitumen remains in the basalt to show what may have been."

II.—NORTH-WEST DIVISION.

Clapp (1925, 1926) visited portions of the North-West Basin during September and October, 1924, during the course of a reconnaissance trip through portions of W.A. He reported unfavourably on the oil prospects of that area. No traces of oil or natural gas had been recorded in the artesian wells. He further considers that the shales are "entirely inadequate" as cover rocks.

Subsequent work may be considered under two headings:—

- (i) The Exmouth Gulf Area.
- (ii) The Areas in the Southern portion of the Basin.

i.—*Exmouth Gulf Area.*

Clapp refers (1925, 1926) to the existence of Oligocene beds containing *Lepidocyclina*, *Cycloclypeus* in the Cape Range, close to North-West Cape. He notes that these beds are folded into an anticline. These observations were made during a reconnaissance trip through the North-West Basin during 1924.

Woolnough (1932) in an air reconnaissance flight around Australia took air photographs in the neighbourhood of Exmouth Gulf. His report* is not available at the time of writing. Photographs of Exmouth Gulf Area are, however, available at the Geological Survey of Western Australia.

The area was visited in 1934 by Condit and Rudd for Oil Search, Ltd., Sydney, and later in the same year by Raggatt. A natural result of Raggatt's more detailed observations in an area which has previously been examined in a very broad manner, is that new geological facts have been brought to light and that a revision of the Geological Map in that area is necessary. Detailed reports have not yet been received.

ii.—*The Southern Area.*

Various areas have been examined in the southern portion of the North West Basin. Most of the work has been of the reconnaissance type, but one area close to the Wooramel River has been examined in more detail. The following areas will be considered:—

An area close to the Wooramel River.

O.P.A. 191H.
 „ 231H.
 „ 235H.
 „ 236H.

(a) —The Wooramel River Area.

The latest and most detailed report on this area is that by Dee and Rudd (1932). The report is accompanied by plans and sections and the earlier work is reviewed.

Attention was first drawn to the area as a result of a hurried visit by Dr. Woolnough and Col. Nicholson, then chairman of directors of the Freney Kimberley Oil Co., in 1928. Woolnough (1928) recommended the area as one with good prospects and well worthy of geological investigation.

* Dr. Woolnough's report was subsequently available and examined after writing present report. Refer to Bibliography —Woolnough, 1932.

Following Woolnough's recommendation, Talbot made a rapid survey of an area 36 by 25 miles. He submitted a report and map to the Wooramel Oil Syndicate. Talbot noted that the area consisted of sandstone, shales with many thin limestone bands and occasional beds of conglomerate, all of Carboniferous age. The limestones were abundantly fossiliferous. With two exceptions in the neighbourhood of fault planes, the dips were all very gentle. Talbot recommended drilling on a structure S.S.E. from Callytharra Spring.

Later the area was visited by Woolnough (1929) and Feldtmann (1929) in company with Talbot. More detailed work than Talbot had been able to carry out in the time at his disposal was recommended. The existence of the dome-like structure found by Talbot was recognised.

In 1930 the area was visited by Hobson. Some time was spent expanding Talbot's work and later an area about Talbot's Cairn (reference point built by Talbot) was mapped in more detail. Faults in the neighbourhood of the Cairn were mapped. It was considered that the most suitable location for drilling was east of a fault near Talbot's Cairn.

April, 1931, saw Talbot and Hobson again in the area accompanied by P. S. Hossfeld. Further information was collected about the Cairn Area. Talbot and Hobson recommended drilling on what appeared to be a closed structure east of the Cairn. Hossfeld and later Woolnough considered a more detailed examination necessary of the section exposed in the Wooramel River and of the Byro Plain for structure. They were agreeable to the drilling as above for geological information.

Dee and Rudd recognised the following stratigraphical sequence:—

- Recent to Tertiary.—Laterites and recent sands. Travertine.
- Jurassic?—Grits and conglomerates 5 feet +.

Unconformity.

Permo-Carboniferous—

- (i) Byro Limestone group 600 feet +
Confined to Byro Plain. Sandy limestone and calcareous sandstone with abundant fossil remains.
- (ii) Wooramel Sandstone group, 800 feet +
Vary from fine grained micaceous sandstone to coarse quartz grits. Fossiliferous in upper horizons. Fauna of this group are intermediate between those of the Callytharra limestones and the Byro limestone group.
- (iii) Callytharra limestone group, 90 feet +
Limestone is grey to brown and varies between a foraminiferal, crinoidal and shelly type. Includes about 5 feet of limestone conglomerate at base. Abundant organic remains.
- (iv) Glacial group, 500 feet +
Glacial grits, tillites and boulder beds.
Acidic and basic igneous erratics occur together with quartzites and metamorphosed limestone beds.

Unconformity.

Pre-Cambrian.—Igneous and Metamorphic Rocks.

The general structure of the area (Dee and Rudd) was shown to be saucer-like with the lowest point some four miles north of Bogadi Outcamp. Faulting is prevalent. The boundary of the Permo-Carboniferous sediments against the igneous and metamorphic rocks to the east and north-west, is marked by faulting. With the aid of aerial photographs various areas were examined for structure, and if necessary these were mapped on a large scale. The results of this work have been collected together by Dee and Rudd, and are shown on a geological map (scale 1 in. = 1 mile). The work around Bogadi, which revealed a saucer-like structure, is shown on a larger scale map (4 in. = 1 mile). Structures of individual areas are discussed in their reports.

Faults are well marked as a result of depositions from ferruginous solutions which have passed along the fault planes.

No indications of petroleum have been recorded in the area. It is considered by Dee and Rudd that leakage might have occurred in the neighbourhood of some of the many faults.

The Callytharra Limestone Series is thought to be a suitable source rock for petroleum. The Wooramel Sandstone Series would provide suitable reservoir rocks. Other conditions necessary for the existence of oil in commercial quantities are not considered to be satisfied. Dee and Rudd conclude that there is doubt as to the existence of suitable cover rocks—none showed up in the section exposed and the chance of their existing in hidden sections is thought to be remote. Both source and reservoir rocks outcrop over extensive areas. No suitable structures were found. Faulting was disclosed immediately to the east of the structure previously recommended for drilling, and it was considered that there was some doubt about its closure. No indication of petroleum is known in this area. For these reasons Dee and Rudd do not recommend drilling.

During the course of their last survey, the area was visited by Woolnough and Hossfeld. Woolnough (1932) was directing an air survey of portions of Australia and the Wooramel area was among those selected. Visual observations were made and photographs of selected areas were made available to Dee and Rudd.

- (b).—An Area South of Carnarvon in the Neighbourhood of Shark Bay—O.P.A. 191H.

This is an L-shaped area extending from just south of Carnarvon to 20 miles south of Hamelin Pool. The lower portion of the L-shaped area extends inland for 100 miles. It was examined by Wade for the Freney Kimberley Oil Co. in 1934. Wade found a large portion of the area covered with drift sands, recent limestones and red sandy plains. Traverses were made in numerous directions over the area and in addition the logs of 70 bores sunk for water were critically examined. In the coastal part of the area, the strata met with in boring are summarised as below:—

Tertiary-Cretaceous.—Yellow, grey and white clays and chalks with some thin bands of limestone near the surface. Occur to depth of 500 feet to 1,000 feet.

Upper Jurassic.—Black or dark coloured shales, sometimes with pyrites, thickness 80 to 250 feet.

Permo Carboniferous.—Grey shales and limestones—800 feet (800 feet thick in Carnarvon bore and apparently absent outside area around Carnarvon). Thin chocolate coloured sandy shales overlying hard pink and grey sandstone and coarse grits—500 feet to 800 feet.

Wade suspects the existence of a buried ridge "faulted down to the eastward toward Peron Peninsula and Dirk Hartog Island by a north-south fault and to the north by an east-west fault which more or less coincides with the lower course of the Gascoyne."

Recent, Tertiary, Cretaceous, Jurassic (?) and Permo Carboniferous strata are passed through in one bore of 3,000 feet. Further changes in conditions of deposition are considered to have been steady and slow.

An unconformity is suspected above the Permo Carboniferous Series, thus giving any oil formed a chance to escape. Conditions are not considered favourable to the formation of oil in the Permo Carboniferous beds.

In the beds above the Permo Carboniferous there is an absence of sandstone beds to act as reservoir rocks. Also any oil which may have been formed would have had a chance to escape eastward after tilting and erosion had occurred.

No evidence of oil has been found in any of the bores which have been put down for water, nor have any surface indications been noted.

Wade makes no drilling recommendation.

(c).—O.P.As. 231H, 235H, and 236H.

In 1932 Blatchford and Forman (1932) visited Boolardy Station to get some first hand information in the field on the occurrence of a stinkstone which had been reported. It was thought it might have some bearing on the oil potentialities of the district. After examination it was concluded that the stinkstone was a superficial formation, having no relation to oil. Most of O.P.A. 236H was found to be granite country. Various samples of stinkstone were collected. Subsequent examination of these by the Government Mineralogist and Analyst revealed no trace of mineral oil.

The eastern edge of O.P.A. 235H lying to the west of 236H was examined and it was considered that 235H warranted further geological work.

To do this work, Forman (1932) set out in September, 1932, and made a traverse over large portions of 235H and 231H which lies immediately to the south. Portions of 223H and 234H were also touched upon. It was found that large portions of the area were covered with sand hills completely obscuring the geology. Good exposures were seen, however, in the southern portion about the Murchison River and in the eastern portion. It was found that a considerable portion of the area was occupied by Permo Carboniferous sediments, overlain by Cretaceous sediments towards the coast, the whole dipping to the west at 1°-2°. No structures were observed suitable for the retention of oil, and it was

recognised that because of the sand further geological work by means of surface observations would be difficult.

O.P.A. 235H was not recommended for immediate further work.

III.—SOUTH-WEST DIVISION.

From time to time numerous indications of oil have been reported from various places, and a certain amount of drilling has been undertaken as a result. In no instances have any of these indications been accepted and confirmed by officers of the Geological Survey of Western Australia. Numerous reports have been written and these are listed in the bibliography. Of these it is sufficient to note Bulletin 65, dealing with the Warren River District, and Bulletin 26 which contains a report on an area about the Princess Royal Harbour.

The occurrence of bitumen on the south coast has already been noted. It has also been noted that it has never been found away from the coast. All writers agree that it cannot be accepted as an indication of petroleum in the districts inland from the beach where it occurs. Specimens were examined in the laboratory by Dr. Simpson, and his observations are recorded in an appendix to Bulletin 65. In his summary, he says: "The South Coast Asphaltum is a true Petroleum residual. It occurs in small masses of identical type along 1,500 miles of coast line and is confined to the immediate vicinity of the ocean. It is capable of having been floated by sea water, and whilst it may be derived from local sources it is more probably the ocean drift from jettisoned or wrecked cargo, or from supplies brought by whalers for caulking their boats."

Other reported indications have been found upon examination to be natural occurrences in swampy regions. No drilling has been recommended.

Recently Forman (1934) has noted that the topographic features near Walyering Peak suggest the existence of what may be a structure suitable for the retention of oil. He considers that more work would be necessary to prove the existence of the supposed structure, and it would also be necessary to examine Permo Carboniferous and Jurassic beds outcropping to the north for possible source beds. No indications of oil were found in the area examined.

IV.—EUCLA DIVISION.

The geology of the Nullabor Plains and the Petroleum possibilities have been summarised by Maitland (1918). A considerable portion of the area is covered by a cavernous limestone of Miocene age. Bores have shown that underlying this are mainly shale and sandstone of Cretaceous age. Thin bands of dolomitic limestone and glauconitic mudstone have also been recorded. Numerous bores have bottomed on granite.

Summarising the evidence available, Maitland says:—

- (1) There is a large area of Tertiary or Late Cretaceous rocks, which contain amongst their members sandstones of varying degrees of porosity.
- (2) The beds dip at very low angles to the south at about 5°.

- (3) The cliff sections of the coast show that the beds are virtually horizontal, and have not been subjected to disturbance, nor in any way thrown into folds.
- (4) No oil seepages have been noticed anywhere in the plateau.
- (5) Asphaltum, a residue of petroleum, occurs amid flotsam and jetsam on the coast, but has not been found anywhere inland beyond possible depositions by the sea.
- (6) There are no known extensive deposits of organic origin anywhere associated with beds of the Nullabor Plains which are capable of producing oil.

5.—DRILLING FOR PETROLEUM IN W.A.

We have already noticed that a certain amount of drilling was undertaken in the S.W. Division in the neighbourhood of supposed indications. This drilling need not be discussed further since no success resulted, nor was any ever likely.

Subsequent drilling has been confined to the Kimberley Division in four localities:—Price's Creek, Mt. Wynne, Poole Range in the Fitzroy Valley, and the Okes-Durack Bore in the Ord River Area.

Price's Creek.

The first showings of oil in the Fitzroy Valley were obtained here. Subsequently, four holes were drilled in this locality ranging in depth from 340 feet to 1,008 feet. Numbers 1 (1,008 feet), 2 (340 feet), and 3 (809 feet), sunk in the vicinity of Price's original bore, all showed traces of oil, while number 4 (444 feet), two miles to the west, showed no indications. Numbers 1, 2, and 3 all penetrated limestones of Lower Carboniferous age throughout their entire depth, while number 4 did not reach these until 444 feet deep. Before this it passed through sandstones and shales. Faulting is suspected between numbers 3 and 4.

Mt. Wynne.

Following early geological work by Blatchford and Talbot, a drilling site was selected and drilling commenced, using a Calyx drill, about the middle of 1922. The first hole was carried to a depth of 894 feet, when it was decided to change to percussion drilling. It was found that the hole was crooked, and it was abandoned. Asphaltum was recorded at several depths, 109 feet, 118 feet 6 inches—121 feet 6 inches, 225 feet and 274 feet (?). The occurrence at 120 feet is described by Simpson (1922) as follows: "This (11 inch of core—R.A.H.) consisted of a firm white sandstone, thickly bedded and traversed by a number of roughly vertical and inclined joints. Nothing resembling bitumen has impregnated the sandstone, but in most of the joints were dendritic films and coatings (up to nearly $\frac{1}{8}$ in. in thickness) of black and brown organic matter as well as kaolin and occasional small masses of pyrite." Two types of carbonaceous matter were present:—

- (1) A brilliant black plastic asphaltum—less abundant than (2).
- (2) A brown porous fragile material, widely distributed in the joints.

Both were considered to be true petroleum residues the second probably derived from an earlier asphaltum.

A second hole was carried to a depth of 2,154 feet. The log of this bore is given in Bulletin 93, and a copy is attached to this report. The log shows that globules of oil were noted at various depths between 524 feet and 1,886 feet. Bitumen was also recorded between these depths and also shallower. A water shut off was attempted at 2,084 feet but failed owing to the shale band being thin and underlain by a friable sand containing water. Drilling was stopped in September, 1925, at a depth of 2,154 feet.

Poole Range.

Following Dr. Wade's visit of inspection in 1924, and work by Blatchford and Talbot at the Poole Range, drilling was commenced. A pilot hole was drilled to a depth of 1,000 feet.

In the main hole 10 inch casing was carried to 1,683 feet (Blatchford 1928), and all top waters were cemented off at this point. Soon after continuing drilling in an 8-inch hole, water entered the hole and rose to within 127 feet of the surface. It is not certain where this came from—whether the cement had failed, or a water sand had been struck below 1,683 feet. Drilling was continued in a wet hole. At 2,085 feet to 2,115 feet and at 2,117 feet to 2,131 feet, shows of oil were obtained. Oil was noticed coating the cable and floating on the water. Drilling was suspended at 2,131 feet and the hole mudded up.

An attempt was made to shut off the water at 2,078 feet and test for the oil which had showed from 2,085 feet to 2,131 feet. After drilling through the cement bridge, water entered the hole and rose to within 242 feet of the surface. Blatchford (1929), considered that this water was coming from the oil sands which had been partially flooded.

Drilling was continued (file 218/21, G.S.W.A.) in a 6-inch hole to 2,605 feet, when a brown shale band was struck. It was decided to attempt to cement off the 5-inch casing at 2,616 feet, still in the brown shale. This was only partially successful, water was reduced to 300-400 gallons per hour.

Drilling was again continued, using 4-inch casing. At 3,138 feet there was a showing of gas with minor quantities of a light oil (Blatchford, G.S.W.A. File 27/30). Cementing was again attempted and was this time successful. The hole remained dry until 3,200 feet was reached, when it was again flooded with water, thought to be coming from another water-bearing stratum.

Drilling was continued to 3,264 feet when the tools were lost owing to the rope breaking and the hole was subsequently abandoned.

It is considered that the best showings of oil were obtained at 2,085 feet to 2,115 feet (Blatchford, G.S.W.A. file 27/30).

Following further consideration of the original mapping of the area, a change in drilling site was proposed. The drawing of structure contours disclosed an apparently suitable structure east of the original drilling site (Blatchford, G.S.W.A., file 27/30).

Drilling was undertaken on a new site to a depth of 1,543 feet and then suspended. The exact location of this site is not known to this Department.

The original hole at Poole Range has been filled in. Attached is a log of this bore.

Okes-Durack Bore—Ord River Area.

Following Mahoney's work in 1922, a bore was drilled, located as shown on the accompanying map, to 1,196 feet. From 788 feet onwards this bore passed through basalt. A log is attached.

6.—WORK NOW IN PROGRESS.

Two areas are being geologically examined—portion of the Kimberley Division of O.P.As. 146H and 186H, and the Exmouth Gulf Area, O.P.A. 258H.

The geological work in the Kimberley Area is being done by Dr. Wade for the Freney Kimberley Oil Co. (1932), of Perth. Wade's interim report has been noted. He recommends that the geological work be continued during this season.

During last year, the Exmouth Gulf Area was visited by Condit and Rudd, and later by Raggatt for Oil Search Ltd., of Sydney. Further work is contemplated in the North-West Basin by the same company.

No drilling is in progress at the present time.

7.—SUMMARY.

From the report it will be seen that the Desert Basin and the North-West Basin have received most attention and that portions of both are now being geologically examined. Traces of oil have been recorded at Okes' find in the Ord River, in Price's Creek bore, in the Mt. Wynne bore, in the Poole Range bore. Numerous "indications" have been reported from the south coast and south-west coastal regions, but these have not been confirmed by officers of the Geological Survey of Western Australia.

A considerable proportion of the geological work has been of the reconnaissance type, but some areas have been examined in detail. There still remains plenty of scope for geological work in the sedimentary areas of Western Australia.

Drilling has been confined to the Kimberley regions, and no success has been recorded. Trouble has been experienced with cementing off water. In the Poole Range bore many water sands were pierced.

APPENDIX.

EXTRACT FROM WADE'S INTERIM REPORT, 1935.

Provisionally the Geological Sequence is as follows:—

System.	Fitzroy Valley Area.	Christmas Creek Area.
Recent	16. Blown sands, flood and river silts. Newer lateritic deposits, etc. 15. Low level terraces with mound forming pebble beds, older sand dunes. 14. High level terraces and pebble beds, older laterites and beds of pisolitic ironstone.	16. } 15. } As in Fitzroy Valley area but with clay breccias containing large angular rock fragments and grit bands of Poole Range Area on horizon of 14. 14. }
Tertiary	13. Clays with reptilian and marsupial remains of Quambun; with insect and plant remains north of Nooncanbah (?)	13. ?
UNCONFORMITY.		
<i>Leucite Lavas, Volcanic Breccias, Agglomerates, etc.</i>		
Strata of Doubtful Age. May be Jurassic	12. Loosely consolidated, false bedded yellow and white sandstones, grits and conglomerates (waterworn pebbles, mostly quartzite). Argillaceous and ferruginous bands (contain worm tracks, lamellibranchs of pecten-like form) of Erskine and Edgar Bas. Strata horizontal tending to form plateaux and mesas with hard "Duricrust" cappings—old peneplain.	12. Loosely consolidated bedded and false bedded sandstones and cherty beds over sandy ferruginous shales—Mesa country of Upper Christmas Creek: dissected old peneplain—may represent lower horizon than beds in Fitzroy Valley Area.
UNCONFORMITY.		
Permian	11. Clays and shales with sandy and calcareous horizons. 10. 2nd Ferruginous Series.—Brown sandy shales and flags with limestone bands—sometimes limonitised, concretionary, ripple marked and false bedded. Richly fossiliferous: worm tracks, cephalopods, Athyris, Dielasmia, Pleurotomaria, Bellerophon, Cardiomorpha, Aviculopecten, <i>Waagenoconcha</i> , Aulostegia, Fossil wood, leaves and fronds—Glossopteris? 9. Grey to blue clays with bands of gypsum and limestones, <i>Productus semi-reticulatus</i> , <i>P. sub-quadratus</i> , <i>Spirifer</i> , <i>Avicula</i> , <i>Strep-torhyncus luluigui</i> , <i>Polyzoa</i> , etc. 8. 1st Ferruginous Series.—Red-brown to almost black sandy shales, flags, coarse grits, conglomerates, ripple-marked and strongly false bedded, concretionary, dark nodular beds with plant remains near base. Flaggy limestones, sometimes partly or completely limonitised, worm tracks, cephalopods, spirifers, <i>Pleurotomaria</i> , <i>Bellerophon</i> , lamellibranchs—pecten types. Fossil wood— <i>Lepidodendron</i> — <i>Calamites</i> , <i>Cordaites</i> , leaves, fronds, etc.	11. As in Fitzroy Valley Area—Beds contain gypsum 10. As in Fitzroy Valley Area. 9. Alternations of clays and flaggy limestones similar to those of Fitzroy Valley area series seem to be thickening in this direction—2,000 feet. 8. As in Fitzroy Valley area but with inter-bedded white to red friable sandstones and coarse grits, and marked absence of ferruginous infiltrations locally: concretionary. Worm tracks, fossil wood and plant remains. Coarse grit and conglomerate with worm tracks at base in places often altered to a peck-marked quartzite—400 feet.

EXTRACT FROM WADE'S INTERIM REPORT, 1935—*continued*.

System.	Fitzroy Valley Area.	Christmas Creek Area.
UNCONFORMITY.		
Carboniferous ...	7. Glacial Series.—Boulder beds interbedded with sandstones of Grant Range. Limestones with glaciated boulders of Mt. Wynne area, clays, sandy shales, etc., beneath. <i>Spirifera hardmani</i> , crinoid stems, etc.	7. Poole Range Area. Glacial series, massive lenticular false bedded sandstones with bands of conglomerate and grit with glaciated pebbles, grey sandy and intensely false bedded shales; grey clays, boulder beds with large striated boulders; huge concretionary limestone masses. Whole series characterised by irregularity of deposition and lenticular character of deposits. Fossil wood in large trunks and fragments in silica or limonite. May reach over 1,000 feet in thickness.
	6. Massive false bedded sandstones predominating, fine-grained and clayey on some horizons. Minor developments of sand shales—2,000 feet.	Extensive development of boulder beds containing huge boulders of many types resting directly on the chocolate and green series (5) and the massive Devonian limestones (4). 6. Massive false bedded sandstones with important seams of argillaceous and sandy shales. Banded, yellow and red cherty beds. Fossil wood common, 1,600 feet.
UNCONFORMITY.		
	5. Absent ?	5. Chocolate-coloured shales with green calcareous bands very regularly bedded. Arenaceous in places: beds of blue shale with calcareous nodules and concretions. No fossils found. Pass down into red flaggy limestones with cephalopods—goniatites, orthoceras, etc., crinoids. May be passage beds from Upper Devonian to Lower Carboniferous, 1,500 feet.
UNCONFORMITY.		
Devonian ...	4. Hard massive limestones impure and sandy in places with cherts—tend to become crystalline. 1,000 feet, Oscar Range, Lennard Range, Mt. Wynne Area.	4. As in Fitzroy Valley Area—Corals, stromatoporoids, <i>Atrypa reticularis</i> , etc. <i>Schizophoria striatula</i> , <i>Spirifera musakheylensis</i> , Bryozoa, <i>Aulopora</i> , etc. 2,000 feet. Basal beds. Thin bedded red limestones alternating with red earthy beds <i>Atrypa</i> . <i>Gasteropods</i> , etc.
UNCONFORMITY.		
Pre-Cambrian Newer	3. Quartzites and quartzitic shales of Nullagine type. Lennard Bore. Mt. Wynne.	3. Quartzites of Nullagine Type—Pillara Gap.
UNCONFORMITY.		
	2. Not seen. 1. Not seen.	2. Granitic rocks invading 1. 1. Metamorphic rocks—mica schists. Areas around Mountain Home Gap and "Blow-em-up" Rough Range.

MT. WYNNE BORE.

Depth.		Description of Strata.	Remarks.
ft. in.	ft. in.		
0 0	to 16 0	Red compressed sand ironstone conglomerate	... 10in. casing to 10ft.
16 0	" 31 4	Hard white sandstone, white clay	
31 4	" 52 0	Red and white sandstone	
52 0	" 68 6	Grey sandstone with bands of white sandstone	
68 6	" 86 4	Hard white sandstone	
86 4	" 94 10	Hard brown sandstone	
94 10	" 106 6	Hard grey sandstone—grey shale	
106 6	" 112 0	Hard brown sandstone	
112 0	" 117 8	Hard grey sandstone	
117 8	" 121 6	Broken sandstone	... Asphaltum in cracks.
121 6	" 126 6	Grey sandstone	
126 6	" 128 6	Brown sandstone	
128 6	" 132 4	Blue sandstone	
132 4	" 142 0	Grey sandstone	

MT. WYNNE BORE—*continued.*

Depth.		Description of Strata.		Remarks.
ft.	in.	ft.	in.	
142	0 to	161	0	Coarse grey sandstone slightly fractured in places
161	0 "	178	6	Sandy shale and broken sandstone
178	6 "	181	0	Sandy shale
181	0 "	202	0	Mudstone-pyrites
202	0 "	218	6	Hard grey sandstone
218	6 "	223	0	Sandstone and pyrites
223	0 "	249	3	Sandstone—sandy shale Bitumen at 225ft.
249	3 "	298	9	Hard grey sandstone Carbonaceous matter from 228ft. to 289ft. 11in.
298	9 "	316	0	Fine-grained fairly soft sandstone
316	0 "	341	2	Medium-grained sandstone and pyrites
341	2 "	361	0	Fine-grained sandstone with coarse bands
361	0 "	371	0	Hard grey sandstone
371	0 "	399	9	Very coarse, hard grey sandstone Carbonaceous matter at 394ft.
399	9 "	406	5	Conglomerate
406	5 "	474	0	Clean sandstone
474	0 "	483	0	Sandy shale
483	0 "	500	0	Hard medium-grained sandstone
500	0 "	505	0	Sandstone and pyrites
505	0 "	513	0	Fine-grained sandstone
513	0 "	524	0	Hard sandstone Sin. casing to 531ft.
524	0 "	528	0	Sandstone and pyrites Globules of oil and bitumen from 495ft. to 590ft.
528	0 "	531	0	Hard sandstone
531	0 "	560	0	Jointed sandstone
560	0 "	626	0	Sandstone—jointed sandstone
626	0 "	717	0	Hard sandstone
717	0 "	727	0	Sandstone slightly softer
727	0 "	734	0	Broken sandstone—very hard sandstone ... Globules of oil and bitumen at 735ft.
734	0 "	890	0	Hard sandstone Globules of oil at 773ft. ; particularly hard band at 867ft.
890	0 "	912	0	Medium to fine grained compact sandstone
912	0 "	1,113	0	Tough, hard, grey claystone
1,113	0 "	1,165	0	Alternate bands of shale and hard grey sandstone
1,165	0 "	1,640	0	Very fine-grained hard friable sandstone
1,640	0 "	1,676	0	Medium to fine-grained sandstone Oil seepage.
1,676	0 "	1,695	0	Fine-grained sandstone Bottom, Nov., 1924.
1,695	0 "	1,716	0	Hard grey fine-grained sandstone with pyrites
1,716	0 "	1,767	0	Very sandy shale
1,767	0 "	1,856	0	Hard grey fine-grained sandstone
1,856	0 "	1,878	0	Medium-grained grey sandstone A few globules of oil came up in sludge.
1,878	0 "	1,886	0	Medium to coarse-grained sandstone Many globules of oil came up in sludge.
1,886	0 "	1,932	0	Very fine-grained clayey sandstone Friable in places.
1,932	0 "	2,084	0	Medium to fine-grained grey sandstone Friable and broken in places—bad drilling.
2,084	0 "	2,099	0	Sandy shale
2,099	0 "	2,113	0	Very broken sandstone with some conglomerate and grit
2,113	0 "	2,145	0	Very broken sandstone with bands of conglomerate and grit
2,145	0 "	2,147	0	Sticky shale
2,147	0 "	2,154	0	Sandy shale

OKES—DURACK BORE.

Depth to Base of Bed.	
7 feet—	Reddish brown mudstone.
34 "	Blue flaggy limestone, with nodular fossils (Girvanella).
58 "	Blue calcareous shale with thin seams of gypsum and thin bands of hard crystalline limestone and some pyrites. Fossils between 45 and 55 feet.
66 "	Blue to grey limestone with nodular fossils.
115 "	Grey brown and blue shale with gypsum and hard streaks.
255 "	Brown mudstone with patches of blue crystals of gypsum present (looks like a flaggy sandstone in places).
267 "	Grey shale with patches of blue.
471 "	Brown to reddish sandy mudstone with bands of grit, veins of crystalline gypsum and small crystals of pyrites.
495 "	Blue-grey shale.
634 "	Brown, sandy mudstone, calcareous in places.
636 "	Grey limestone, water rose to within 9ft. of surface.
657 "	Brown mudstone.
663 "	Thin limestone cap covering hard banded chert.
788 "	Grey limestone, crystalline, hard and massive. Gas noticeable in sludge. Petroliferous odour. Slightly fetid from presence of sulphur ; brecciated chert in lower few feet.
1,196 "	Light blue to grey basalt.

OKES—DUKACK BORE—*continued.*

Depth to Base of Bed.	
1,196 feet	The basalt is ashy at the top, also at 851ft. ; 867ft. ; from 1,007ft. to 1,035ft. ; from 1,099ft. to 1,124ft. ; from 1,134ft. to 1,180ft., and is vesicular between 978ft. and 1,007ft. It is well jointed in places, the joint faces being coated with a waxy mineral at 800ft. This has been determined as Nontronite, a hydrous silicate of magnesium and iron.

FRENCH-KIMBERLEY OIL COMPANY, LTD.

Log of Bore at Poole Range.

ft.	ft.	
...	156	Yellow sandy clay.
...	176	Dark grey shale.
176—212		Very dark shale.
212—218		Very broken sandstone.
218—340		Grey shale
340—404		Grey shale with thin limestone bands.
404—408		Very fine-grained calcareous sandstone.
408—538		Grey shale.
538—540		Calcareous sandy shale.
540—560		Grey shale.
560—587		Tillite.
587—628		Grey shale.
628—670		Grey sandy shale.

FRENEY-KIMBERLEY OIL COMPANY, LTD.—*contd.*

Log of Bore at Poole Range.	
ft.	ft.
670-696	Hard grey shale.
696-717	Hard grey sandy shale.
717-797	Very fine-grained sandstone.
797-810	Grey shale.
810-834	Hard grey shale.
834-908	Grey sandy shale with hard bands.
908-937	Grey shale.
937-950	Very sandy shale.
950-966	Sandy shale darker in colour.
966-1,013	Grey shale.
1,013-1,023	Very sandy shale.
1,023-1,037	Sandy shale.
1,037-1,290	Clayey sandstone.
1,290-1,295	Grit.
1,295-1,370	Grey shale.
1,370-1,467	Clayey sandstone.
1,467-1,586	Very fine-grained sandstone.
1,586-1,590	Very sandy shale.
1,590-1,593	Sandstone.
1,593-1,604	Very sandy shale.
1,604-1,642	Alternate bands of shale and sandstone.
1,642-1,645	Puggy shale.
1,645-1,650	Sandstone.
1,650-1,660	Very fine-grained sandstone.
1,660-1,672	Alternate bands of shale and sandstone.
1,672-1,683	Puggy shale.
1,683-1,687	Puggy shale.
1,687-1,693	Fine-grained sandstone.
1,693-1,729	Clayey sandstone.
1,729-1,737	Incoherent sandstone.
1,737-1,779	Fine-grained sandstone.
1,779-1,805	Fine-grained sandstone.
1,805 ...	In sandstone.
1,867 ...	In clayey sandstone.
1,948 ...	Still clayey sandstone.
2,023 ...	Sandy shale, 1,950ft. to 1,980ft. shale with bands of limestone to present bottom, country very hard from 1,950ft.
2,115 ...	Fine-grained sandstone from 2,043ft. Thick oily substance coming to surface of water in borehole and coating drilling cable from 2,085ft. to 2,115ft. Rock fine sandstone. Water in borehole fallen 15ft.
2,131 ...	Oily matter still coming up; borehole plugged. Decided cease drilling pending instructions from Board. Sandstone coarser.
2,131-2,180	Fine-grained sandstone.
2,180-2,243	Very fine-grained sandstone.
2,243-2,246	Hard clayey sandstone.
2,246-2,293	Fine-grained sandstone with hard bands.
2,293-2,303	Sandy shale.
2,303-2,395	Fine-grained sandstone, clayey in places.
2,395-2,405	Sandy shale.
2,405-2,421	Fine-grained sandstone.
2,421-2,426	Sandy shale, slightly darker.
2,426-2,439	Fine-grained sandstone.
2,439-2,468	Fine-grained clayey sandstone.
2,468-2,498	Fine-grained sandstone slightly clayey in places
2,498-2,507	Hard clayey sandstone.
2,507-2,522	Coarser sandstone.
2,522-2,605	Fine-grained clayey sandstone.
2,605-2,616	Light brown shale.
2,616-2,626	Light brown shale.
2,626-2,642	Very fine-grained sandstone.
2,642-2,670	Very fine clayey sandstone.
2,670-2,674	Brown calcareous shale.
2,674-2,685	Fine-grained sandstone.
2,685-2,738	Very fine-grained sandstone.
2,738-2,766	Fine-grained sandstone (bottom on 20th June, 1930).
2,766-2,771	Brown shale, slightly calcareous.
2,771-2,780	Fine-grained sandstone.
2,780-2,786	Fine-grained sandstone with bands of shale.
2,786-2,791	Fine-grained clayey sandstone.
2,791-2,796	Brown sandy shale.
2,796-2,802	Fine-grained sandstone.
2,802-2,822	Brown shale, slightly calcareous.
2,822-2,861	Very fine-grained sandstone.
2,861-2,871	Medium grained sandstone with numerous specks of a black mineral (tourmaline?).
2,871-2,920	Medium-grained sandstone—probably water bearing.
2,920-3,048	Sandstone.
3,048-3,119	Fine-grained sandstone.
3,119-3,138	Extremely hard grey shale, but last 18in. softer. Bore cemented off at 3,138ft. 4in. casing.

FRENEY-KIMBERLEY OIL COMPANY, LTD.—*contd.*

Log of Bore at Poole Range.	
ft.	ft.
3,138-3,156	Extremely hard grey shale.
3,156-3,200	Hard brown shale.
3,200-3,215	Sandstone.
3,215-3,220	Puggy brown shale.
3,220-3,246	Fine-grained clayey sandstone.
3,246-3,264	Logs not available.

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SUMMARY OF THE RESULTS OF THE GEOLOGICAL SURVEY AT BURGESS' FIND.

(South of Burracoppin, Avon District.)

By R. A. HOBSON, B.Sc. (Hons.).

The portion of Mining Reserve 20542 examined consists of an area of gabbro, diorite, diorite gneiss and metamorphosed sediments, intruded by pegmatite dykes, aplite dykes and quartz veins, and surrounded on three sides by granite. It would appear reasonable to conclude that the pegmatite dykes and quartz veins are offshoots from the main granite mass. As outcrops in the area are few and the mine workings are not extensive, no evidence could be obtained to indicate the relationship of the gabbro, diorite and metamorphosed sediments. The gabbro and diorite may be differentiation products from the one magma. The diorite gneiss is considered to be a primary gneiss.

The diorite group is characterised by an abundance of brown hornblende. Hypersthene and augite occur as additional ferromagnesian minerals.

A noticeable feature of the basic rocks is their freshness. When examined in thin section the constituent minerals appear for the most part quite unaltered. The feldspars are clear and glassy.

The rocks of the area have not been subjected to high pressure, although the temperature must have been fairly high. The metamorphosed sediments although gneissic in hand specimen show no cataclastic features in thin section.

Extensive faulting was not observed, and all appeared to be pre-gold.

Shear zones are not extensive and on G.M.L. 13PP. provided the channel along which the gold was subsequently introduced. Remnants of the shear zone provided an "indicator" which had been followed from the surface. The main shear zone in 13PP. is almost vertical. Two shear zones dipping at 35 degrees to the east were observed, one on G.M.L. 13PP. (winze from 105ft. level) and the other on P.A. 179PP. Neither exceeded 2 feet in maximum thickness.

The gold occurs in quartz veins and may extend into the country. The maximum thickness of any gold-bearing quartz vein observed would be less than 2 feet, although a maximum thickness of 3 feet 6 inches is said to have been reached on G.M.L. 5PP. The veins are irregular in shape, rapid variations in thickness are characteristic. Values pitch to the north.

On G.M.L. 5PP. the average width of the stoping appeared less than 4 feet, while on G.M.L. 13PP. it would not exceed 5 feet.

Because of the occurrence of secondary gold, values will decrease below the level of permanent water. Water has not yet been reached in any of the mines. The difficulty of mining will increase with depth, as in the lower levels of G.M.Ls. 5PP. and 13PP. hard unweathered rock has just been reached.

NOTES ON SOME MINING GROUPS IN THE YILGARN GOLDFIELD.

By R. A. HOBSON, B.Sc. (Hons.).

The following groups are briefly discussed hereunder:—

The Jaccoletti Group:

Comet G.M.L. 3455.
Gentle Annie G.M.L. 3472.
Lenodo G.M.L. 3431.
Jaccoletti South G.M.L. 3542.
— G.M.L. 3632.
Four Three's G.M.L. 3541.
Prospecting Areas.

The Glendower Group:

Evelyn Molly G.M.L. 3512.

Lenneburg's Group:

P.A. 3211—Old Onehunga lease.

The Burbidge Group:

Great Victoria United G.Ms., N.L.—G.M.L. 3480 and others.
Prince George G.M. (late Broncho G.M.)—G.M.Ls. 3468, 3567, and others.
Mammoth Ore Mines G.M.L. 3565 and others.
Grand National G.M.L. 3707.

JACCOLETTI GROUP.

Although the name Jaccoletti is no longer in use on official maps, etc., for the group now to be described, it is proposed to revive it as being convenient. The Jaccoletti group includes all those G.M.Ls. and P.As. immediately to the W. of the present townsite of Marvel Loch, and the name serves to distinguish this group from the group of mines immediately to the E. of Marvel Loch townsite. It includes the old Jaccoletti mine (now renamed the Lenodo), one of the older gold mines of this State, and the old Mountain Queen G.M., which in the past was among the larger producers of the southern portion of the Yilgarn Goldfield. There is a considerable variety of rock types in this area, and exposures are, perhaps, better than in other areas examined, but are still not continuous along the strike of the rocks for any appreciable distance.

In general the S.W. portion of the area contains more acid than basic sediments, while the N.E. portion contains more basic than acid sediments. The basic sediments of the N.E. portion may be traced north-easterly into those of the Marvel Loch group. Included in this area of basic sediments but outside the area now being discussed are two lava flows. The major part of the basic sediments are fine grained, but medium and coarse grained varieties are to be found. Included among these are two rather characteristic types. The "Magpie Rock" found in the

Jaccoletti G.M., and immediately to the south, is a dark coloured rock with defined gneissosity, and probably containing appreciable quantities of biotite. It differs from the more usual basic sediments, but has been recognised elsewhere in the goldfield. The other characteristic type is a light yellowish green rock composed of interlocking needles probably of a light coloured amphibole. Unfortunately it cannot be traced along its strike, and is often only exposed in shallow shafts or costeans. The basic sediments are sometimes garnetiferous.

The acid sediments are quartzites, which often form bold outcrops, light and dark grey shales, grey micaceous schists, fuchsite mica schists, micaceous conglomerates, and "running sands." They are often abundantly garnetiferous. Outcrops are good, but not continuous along the strike. The acid sediments may also be well seen in the underground workings.

Pegmatite dykes are abundant and are often very garnetiferous.

Gold occurs either in quartz veins or in lodes. The former usually occur in basic sediments, but many of the smaller quartz veins occur at the junction of the basic sediments and the acid sediments. The old Mountain Queen G.M., the largest producer in the past, worked a lode occurring in acid sediments at no very great distance from a junction with basic sediments. The general strike of all ore bodies is N.W.-S.E., while their dip may be either to the N.E. or to the S.W. at high angles. The ore bodies arrange themselves *en echelon* along four general lines: The Comet-Eclipse line, the Gentle Annie-Geelong line, the Jaccoletti Mountain Queen line, and the Four Three's line.

The strike of the country is N.W.-S.E. and the dip variable. The general dip of the country is to the N.E., but much local folding has occurred in, at least, parts of the central portions of the area. Two series of drag folds were observed, those having a relatively flat pitch (5° - 30°) to the north or south and those having a steep pitch (70°) to the south.

Comet G.M.L. 3455.—The present lease includes both the old Comet workings and the old Eclipse workings. Very little work has been done on either of these since Bulletin 63* was published. Of the old Comet workings very little can be seen at the present time. The lowest level at 224 feet is now not accessible, due to water. It is possible, however, to get into the top of the old stope from this level. A considerable portion of the remainder of the workings has been mullocked, and it is not proposed to describe them. At the time of my inspection no face was accessible.

The old Eclipse West workings are now inaccessible.

Plans and sections of both of these workings were published in Bulletin 63.

The old Eclipse East workings are partially accessible, and were examined by my colleague Mr. R. S. Matheson. In preparing these notes full use has been made of his notes, plans and sections. Only the upper level was examined. The ore body is a lenticular quartz vein, reported to have had a maximum width of 4 feet, and occurring in basic sediments. It strikes N.W.-S.E. and dips to the N.E. at a high angle. The greatest stope length observed was 80

* G.S.W.A. Bull. 63: The Geology and Mineral Resources of the Yilgarn Goldfield, Part II., The Gold Belt South of Southern Cross, by T. Blatchford.

feet. The vein has been displaced three times by three parallel faults, each dipping to the N.E. at 25°, but each time the displacement has been small.

Access to the workings is gained by means of a vertical shaft north-west from the old main shaft. This shaft has a vertical depth of 97 feet but is not accessible below 73 feet. At this depth there is a drive which may be followed until the old main shaft is reached. This is the only portion of the workings which could be examined.

All three workings contain pegmatite dykes. These appear to be less abundant in the Eclipse East workings than in the other two. All three are characterised by flat faults which have cut off the reef. In the old Comet G.M. the fault channels are occupied by pegmatite dykes of appreciable thickness, indicating that these permatite dykes are younger than the quartz reef.

Gentle Annie G.M.L. 3472.—This lease was examined by Mr. R. S. Matheson and the following notes are compiled from his plans and notes.

A series of shafts have been sunk from time to time on this lease, but only two are accessible at present, and active work is confined to one of these. The shaft now being worked has reached a depth of 108 feet. From this level a winze has been sunk to 168 feet and a drive put out in a northerly direction. There is also a level at 61 feet, the north end of which is mullocked.

The ore body is a quartz vein varying rapidly in thickness from a maximum of 3 feet 6 inches to a few inches. It occurs in basic sediments a few inches away from the junction with acid sediments. The dip is generally to the north-east, but south of the shaft now in use the dip has become vertical. Post quartz faulting has occurred.

Lenodo G.M.L. 3431 (Old Jaccoletti Lease).—Recently a ten-head battery has been erected on this lease.

The old workings are not now accessible below 120 feet. At this level there is a drive extending south-easterly for 260 feet, portion of which is accessible, through an old stope, from the level above. For about 90 feet from the shaft the ore body has been stoped to the 78ft. level. The whole of the 78ft. level is accessible and the ore body has been more or less completely stoped to the surface. A shaft has been sunk from the surface to cut the north end of the 78ft. level and has been continued below this to 178 feet. The ore body has been driven on for a few feet at this level, but this work was not being continued at the time of my visit.

About four chains east of the old main workings a shaft has been sunk to 63 feet, and driving on a narrow quartz vein had just been commenced at the time of my visit. A certain amount of material had previously been taken from the 40ft. level of these eastern workings, all said to have come from small erratic quartz veins. Minor faulting was observed in these workings.

The ore body in the main workings is a lenticular quartz vein, striking north-west and south-east and dipping to the north-east at 85 degrees. It is quite free from faulting. The country is "magpie" rock, previously described in the section of these notes dealing with the general geology of the Jaccoletti group. The ore body appears to have been intruded

along the planes of gneissosity. No additional shearing is apparent in the country immediately in contact with the ore body.

The average grade of the ore from the Jaccoletti G.Ms. and early companies producing from the same group of leases, for the period 1900-1916, together with a small production from the Lenodo in 1933 is 9 dwts. It is to be noted that ore was obtained from many small workings on leases in the vicinity of the main Jaccoletti workings, but that the major portion of the ore must have come from those workings.

Jaccoletti South G.M.L. 3542.—Nine shafts have been sunk at various times on the ground now occupied by this lease. At the present time only two of these are accessible.

Close to the north boundary a shaft has been sunk to 110 feet and there are drives extending northerly for 50 feet and southerly for 75 feet at this level. In the south drive a winze has been sunk for 35 feet. Above the south drive the ore body has been completely stoped to the surface, where it was originally worked by means of an open cut.

Where seen in the south face of the south drive, 110ft. level, the ore body is a lenticular quartz vein having a maximum width of six inches, occurring in silicified acid sediments. Its dip is vertical. The average width of the stoping above the 110ft. level would be about four to five feet, indicating that the vein had previously been wider.

In the winze a quartz vein having a maximum width of 5 feet has been exposed. Values are erratic and the country is exceedingly hard.

The acid sediments in which the ore body occurs in the form of a narrow wedge are enclosed on the north, east, and west sides by "magpie rock."

The other accessible shaft is at the south end of the workings, and has reached a depth of 84 feet. There is also a level at 59 feet. The ore body is a quartz vein which varies rapidly in thickness and occurs at the junction of acid and basic sediments. It has a N.W.-S.E. strike and dips to the S.W. at moderate angles. Much minor faulting parallel to the ore body was observed.

G.M.L. 3632.—At the time of my visit this lease was not being worked and the lessees were apparently absent from the district. In the past numerous shafts have been sunk on the area now included in this lease, but only two are now accessible. The deepest of these goes to 74 feet with levels at this depth and also at 53 feet. At 53 feet a quartz vein, dipping westerly at 25 degrees, has been worked to some extent.

The western portion of the lease is mainly composed of acid sediments and the dumps show garnet schists, mica schists and conglomerates. These latter are not abundant. The shafts on the west portion of the lease have all been sunk in very fine grained basic sediments, and are evidently all very old.

Four Three's G.M.L. 3541.—This is the most southerly lease of this group. Three shafts exist in the north-west corner of this lease, the deepest of which has reached 110 feet. From this shaft there are levels at 110 feet, 82 feet and 35 feet. These more recent workings have connected with some older workings to the north. Immediately to the south

there is a shaft 68 feet deep, with levels at 68 feet and 40 feet. The whole of the workings referred to above are included in an area 150 feet by 50 feet.

The workings occur at or close to a junction of acid and basic sediments, striking N.W.-S.E. and with a vertical dip. Extensive minor faulting has occurred at the junction of the two types of rock, and it is along these faults that the gold solutions appear to have travelled. Exceedingly good values, 8 to 9 ounces, are said to have been obtained from very small ferruginous quartz veins and masses. Values also occur in the basic sediments but are generally low and there has been no attempt to work these extensively.

P.As.—Six *P.As.* were in existence in this area at the time at which the work was done. Values are low and with one exception all have been previously worked as *P.As.* or *G.M.Ls.*

The old Mountain Queen lease is now being worked as two *P.As.* The old main shaft and workings to the north of this are included in one *P.A.*, while the southern portion of the old workings are included in the other. On the northern *P.A.* a small three-head battery has been erected. Except for the southern portion of No. 1 level the old workings of the Mountain Queen *G.M.* were not examined.

THE GLENDOWER GROUP.

Two main lines of lode are found in this area—the eastern line, on which the Evelyn Molly, *G.M.L.* 3512, is situated, and the western line, which has at its south end the old Glendower mine, now being worked as a *P.A.* The Evelyn Molly is the only *G.M.L.* in the group, and *P.As.* are not abundant. They are to be found north and south of the Evelyn Molly, and to the north of the old Glendower mine. Values are contained in quartzites, and are generally low. Hand sorting of the ore is often resorted to.

The area is composed of fairly wide alternating bands of basic and acid sediments. The wider basic bands probably contain numerous fairly thin bands of acid sediments, which may be lenticular, and similarly, the wider acid bands contain thin lenticular bands of basic sediments. One relatively thin band 12 feet in thickness of acid sediments—mainly quartzites, but with associated shaly bands—is the lode, which is being worked in the Evelyn Molly, and *P.As.* to the north and south. In places this forms a relatively conspicuous outcrop, and can, with the aid of the underground workings, be traced across the area examined.

The strike of the country is N.W.-S.E., and the dip generally to the west at steep angles. In places, however, it may be vertical. Two series of folds have been recognised, those having an axis pitching to the south at a fairly high angle, and those having a horizontal or nearly horizontal axis. These folds take the form of fairly gentle bends in the beds. They are also to be found in the lodes.

Evelyn Molly G.M.L. 3512.—It has already been noted that this is the only *G.M.L.* in this group. Six shafts exist on this lease. One of these was only partially completed at the time of my visit, while at least two of the others were quite inaccessible. The main haulage shaft has been previously sunk to 110 feet but at the time of my visit was inaccessible below 56 feet. At 56 feet the lode has been driven

on north and south. Beyond about 70 feet from the shaft the north drive was completely blocked by broken ore, which was being removed at the time of my visit. A considerable amount of stoping has been done from this level.

The lode can be seen to consist mainly of banded limonitic quartzites, but also to contain shaly bands, to be 12 feet thick, and to be bounded on either side by basic sediments, with faults at the junctions. Exactly similar conditions are seen in a *P.A.* to the south of the Evelyn Molly.

Values are low and not confined to any one portion of the lode.

LENNEBURG'S GROUP.

There are no existing *G.M.Ls.* in this group and only four *P.As.* Values are generally low and no *P.A.* is being very actively developed.

Values are contained in quartzite bands, up to 20 feet in thickness occurring in a wide band of basic sediments. The strike is N.W.-S.E. and the dip westerly at fairly high angles. Outcrops are exceedingly poor. Except where seen to occur in underground workings, which are few in number, it is not possible to trace the quartzite bands along their strike. To the north-east and south-west the basic sediments are bounded by acid sediments. It is probable that the wide band of basic sediments contains many narrow bands of acid sediments, the presence of which is indicated by the occurrence of chips of quartzite in soil covered areas, having all the other characteristics of an area overlying basic sediments.

P.A. 3211.—Old Onehunga lease *G.M.L.* 956. On this *P.A.* there are at least two well defined quartzite bands extending over its length. Both have a general strike N.W.-S.E. and dip to the S.W. The eastern band is banded limonitic quartzite, while the western one is a white banded quartzite containing no obvious iron. There are no extensive workings, and only in one instance has either lode been driven on for more than a few feet. These workings had been commenced when the field work for Bulletin 63 was being done, and were examined by Mr. Blatchford. Values are generally low.

There is also another band of acid sediments to the west of the western quartzite band referred to above. Four or possibly five shafts have been sunk on this band but no driving has been done.

One or two shallow shafts have been sunk on the other *P.As.* of this group with no results of interest.

THE BURBIDGE GROUP.

All leases in the vicinity of the townsite of Burbidge are included in this group, and among these are the Great Victoria group of leases. In the past these have been among the larger producers of the southern portion of the Yilgarn Goldfield, having produced during the period 1906-1927 34,810.41 ounces of gold from 208,121.26 tons of ore treated. A very considerable portion of the area is covered with laterite, soil or alluvium, and supports a vegetation only of scrub and scattered mallee. Rock outcrops are found only on the high ground in the vicinity of the workings.

Both acid and basic sediments are found; the former predominating in the surface exposures and the underground workings. Generally values are confined to acid sediments. Two main types of these are found—a siliceous variety consisting of quartzites and “running sands,” and a metamorphosed argillaceous variety now existing as a grey micaceous shale or sometimes as a *knotenschiefer*. The former of these two types contains the values, which, in a broad way, are controlled by structural features, and which, in any individual mine, may be very irregular. It is significant that the Great Victoria G.M., the only mine which has been worked to any extent, is structurally very different from the other mines of this group. In two groups of leases the values occur in “running sands” at no very great distance from a junction with basic sediments, but not actually at the junction, as is often the case in the southern portion of the Yilgarn Goldfield.

Where they outcrop the lodes form relatively conspicuous features and are very ferruginous. Throughout the mine workings also the “running sands” are often ferruginous. The iron may be distributed more or less evenly throughout the rock or may be concentrated into masses of irregular shape. Most of the iron seen in the workings is secondary, having originated from banded ferruginous quartzites, or from sulphides, which are said to have been found in the deeper and now inaccessible portions of the Great Victoria G.M. Values are often much higher in the ironstone nodules than in the surrounding sandstone, thus indicating the probability of considerable secondary solution and deposition of gold.

The gradual conversion of the “running sand” (originally a quartzite or sandstone) to a jasper is well shown, and almost every stage can be observed. The first stage is the formation of an earthy light yellow-brown coloured mass, without a conchoidal fracture. With further change this becomes glassy, and a conchoidal fracture develops. In a few places a milky white jasper with red patches and streaks has formed.

The dip of the beds is generally to the east at high angles but may be vertical. Westerly dips were observed in the S.E. portion of the area. The general strike is north and south.

Two main general lines of lode occur, one on the east side—the Great Victoria line, and one on the west side—the Prince George (late Broncho) line. The grey *knotenschiefer*, first observed in the Great Victoria workings, can be traced south from there, through the Mammoth Ore Mine’s workings and thence to the Grand National lease. The outcrop is not continuous—soil and laterite areas intervene—but it is reasonable to assume that the same bed occurs in all three places. The Prince George G.M. lode loses itself to the south in a soil-covered flat and to the north in an area of laterite.

The Great Victoria workings occur in a moderately large drag fold pitching northerly at 70°-80°, with the beds dipping generally to the east at about the same angle. The structure indicated is the east limb of a northerly pitching anticline or the west limb of a similarly pitching syncline. Drag folding of a size comparable to that of the Great Victoria was not observed elsewhere in the area.

So far reference has been made only to folds having a steeply pitching axis. There are also present folds having a horizontal or nearly horizontal axis trending in a general N.-S. direction.

Great Victoria United G.Ms., N.L., G.M.L. 3480 and others.—This company controls a group of leases about the old Great Victoria workings. At the present time a plant is being erected, primarily to treat laterite and surface ore, but subsequently to treat ore which may be broken from depth.

The Great Victoria has previously been worked to a depth of 283 feet. At this depth a crosscut extends north-easterly for 410 feet, and is said to have a winze sunk for some 40 feet. Unfortunately, as water has risen in the old main shaft to 260 feet, this level is not accessible at the present time. Access to the workings may now be had either through the Hamilton shaft or by means of an inclined shaft to the bottom of the open cut, and thence to the 102 foot level. From there the old main shaft continues to the 246 foot level and below. The top portion of the old main shaft has been completely removed in the open cut. The 102ft. level is heavily timbered and appears to be worked out. At 164 feet there are two parallel drives, extending in a N.W.-S.E. direction with their associated crosscuts. No stoping has been done at this level. Below this there is a crosscut extending north-east at 246 feet, and water at 260 feet.

The Great Victoria lode formation consists of a sandy ferruginous formation, occurring between a belt of basic sediments on the south side, and a band of *knotenschiefer* or grey shale on the north side. It has already been noted that this is folded into a moderately large drag fold with a steep northerly pitch. The width of the lode formation varies with its position in the fold. About the Hamilton shaft it has widened considerably, due to buckling within itself and the values have dropped accordingly. Below the north-west end of the open cut, and at the 60ft. level, south-east end of the open cut, the dip is to the north-east, while at greater depths at the south-east end the formation dips to the south-west, or is vertical. Drag folds observed in the workings indicate the presence of folds having a horizontal or nearly horizontal axis.

Values are erratic and scattered throughout the lode formation in those portions of the workings now accessible. Because of the steep pitch of the drag folds it would seem probable that the shoots will be found to pitch to the north.

Minor quantities of vein quartz are observed in the workings.

Prince George G.M. (late Broncho G.M.), G.M.Ls. 3468, 3567 and others.—Previous work has been confined to the north and south ends of the present workings, but only the old workings at the south end are accessible. A lode formation is being tested by means of some eight shafts, extending in a north-south direction, with crosscuts east and west from each shaft. At the south end there are levels at 125 feet and 198 feet and associated crosscuts. Nos. 1, 2 and 3 shafts at the south end are connected by drives.

Acid, basic and intermediate sediments have been recognised. The basic sediments occur on the east side of the lode formation, and generally contain no

values. The lode formation resembles that of the Great Victoria, but is less ferruginous. "Running sand" is abundant.

Average values are low, and from information disclosed in the present crosscuts appears to be generally about 4 dwts. They extend over varying widths up to 120 feet.

The dip of the beds is generally eastward, but is variable. At the south end of the line of workings gentle folding in two directions is apparent. Axes trend parallel to the lode and have either a steep or flat pitch.

Mammoth Ore Mines, G.M.L. 3565 and others.—On G.M.L. 3565 one shaft has been sunk to 97 feet with crosscuts east and west at 53 feet and 97 feet and is entirely in acid sediments. The crosscuts at 97 feet have disclosed values in three places—for 26 feet in the west crosscut and said to average less than 2 dwts., for 15 feet about the shaft and said to average 2 to 3 dwts., for 14 feet at the east end of the east crosscut and said to average 4 dwts. Values in the 53ft. level crosscut are said to average 2 dwts. for about three feet at the west end, and about 2 dwts. over the whole of the east crosscut. General average values would therefore appear to be just over 2 dwts. At the time of my inspection another shaft was being commenced about five chains north from the one described above.

The continuation of the Great Victoria lode formation outcrops on the crest of the hill, which occupies a considerable portion of G.M.L. 3565, but here contains no values. The formation in which the values occur in this G.M.L. lies about half-chain east from the Great Victoria formation, and is separated from it by a band of grey shales. It consists of quartzites, "running sands" and white micaceous shales, with abundant ferruginous patches.

Grand National G.M.L. 3707.—Six shafts have recently been sunk on this lease, all in very ferruginous formation, which appears to be the continuation of the Great Victoria lode. At the time of my visit only two of these were accessible. The probable continuation of the grey shales seen on the Great Victoria leases is found on the east side of the hill on which the shafts have been sunk, while immediately west of an old shaft at the north end of the lease basic sediments are exposed in a shallow costean. The north-south continuation of these basic sediments cannot be traced. Their width would not exceed a few chains. It would appear probable that these may be the same horizon of basic sediments as seen at the Great Victoria, but because of areas of soil and laterite this fact cannot be proved.

To the west of G.M.L. 3707 there is an area of laterite, which contains some values, and which has recently been tested by a series of pits. The results of this work are not known to the writer.

NOTES ON SOME MINING GROUPS IN THE YILGARN GOLDFIELD.

By R. S. MATHESON, B.Sc.

EDWARD'S FIND.

This is the most recent discovery of any note in the southern portion of the Yilgarn Goldfield, and has yielded some excellent crushings of high-grade

gold from a white quartz: the quartz occurs as discontinuous lenses of more or less short length and depth, occurring in drag folds in basic sediments with a gneissic banding.

The quartz reefs vary from a few inches to 6 feet in thickness and follow the general north-westerly trend of the enclosing basic sediments

The reefs, so far discovered, show a strong tendency to variation in thickness both along the strike and down the dip, and the gold content of the quartz varies considerably. The usual conception of there being a "gold line" does not apply to Edward's Find.

"Cricket," G.M.L. 13PP.—Two quartz reefs which strike north-westerly and dip steeply to the west with the enclosing basic sediment country, have been mined on this lease. A thin band of acid sediments interbedded with the basic sediments, lies to the west of the main workings and is exposed in the 50ft. level west crosscut in the shaft just beyond the south boundary of the lease.

The main workings are near the south boundary of the lease. Here "the reef strikes 330 degrees and dips to the west at 80 degrees, being practically vertical for the upper 50 feet. It has been worked in three levels from two shafts sunk to 78 feet and 155 feet, respectively, vertical depth below the brace, situated to the east of the reef and one chain apart."*

Stoping with respect to the centre of the northern shaft is as follows:—

At the 78ft. level, the reef has been stoped 33 feet north-westerly and 138 feet south-easterly, there being a blank in the south-easterly stoping between 42 feet and 66 feet. The stoping has been carried upwards to the 54ft. level and downwards to the surface of a large granitic dyke, the occurrence of which is mentioned in a separate report by Mr. H. A. Ellis.**

At the 54ft. level, stoping 27 feet north-westerly, 92 feet south-easterly and overhead for 20 feet vertical, has been carried out.

On the 34ft. level the ore body has been mined to 10 feet from the surface, the stoping running 15 feet north-westerly and 7 feet south-easterly from the shaft of reference.

Stoping has been done from one other shaft on the lease, and here a small rich shoot which pitches steeply north-west and reported to average 3 ounces of bullion per ton over the plates, has been mined.

In the 34ft. level south-east drive, stoping has been carried out from 12 feet to 25 feet from the shaft and upwards to the cement. The quartz is continuous along this level and there is two feet of quartz in the face of the S.E. drive, and three feet on the face of the N.W. drive, but only the portion which has already been stoped was payable.

On the 62ft. level stoping has been done south-east of the shaft, between 4 feet and 19 feet. Overhead stoping to the 34ft. level and underhand stoping for 19 feet vertical depth has been done. The ore body is cut off below by a fault whose strike is N. 70 deg. W. and dip 15 deg. N. No evidence can be obtained giving the relative movement

*Report on James, Nelson & Goodins G.M.L. 13PP., Edward's Find, by H. A. Ellis.
** See p. 58.

on this fault, but judging from similarly disposed faults in this vicinity, there is every likelihood of a continuation of the ore body being found to the west.

Sunshine, G.M.L. 12PP.—Numerous quartz reefs with varying strikes have been exposed in the workings on this lease. The quartz is lenticular both horizontally and vertically.

In the Whip shaft, near the south boundary, the reef dips 80 degrees south-westerly and has a N.W. trend. The ore body has been stoped out to the 75ft. level, the maximum stope length being 90 feet and maximum stope width 4 feet. Stopping has been discontinued where the quartz has thinned to a stringer or where the values have become too poor. At 113 feet vertical depth in the shaft is a flat pegmatite dyke 10 feet wide which is said to dip south-easterly. The ore body has been faulted here and pegmatite has come in along the fault. No considerable displacement accompanies the faulting. There is a short east crosscut at 180 feet vertical depth in which is exposed a quartz reef, 2 feet wide, containing sulphides.

No work has been done on this reef yet, although it is said to average 10 dwts. gold per ton. At the northern extremity of the driving on this reef, a pegmatite has just been encountered which will hamper any future work in that direction.

From the level at vertical depth 62 feet, between the two shafts near the north boundary of this lease, stoping has been carried to within 12 feet of the surface. The stope length is 55 feet and maximum stope width is 4 feet.

Edwards' Reward, G.M.L. 11PP.—In the north shaft a quartz reef, maximum width 3 feet, has been stoped from the 51ft. level to the surface, over a length of 107 feet. There has been faulting along the floor of the 51ft. level drive, and the footwall has been displaced 8 feet east with respect to the hanging wall. The dip of the fault is reported to be approximately 50° N.

About 25 feet of driving has been done at the 107ft. level in this shaft, and a quartz reef, average width 1 foot, is exposed. Values here are reported to be 4 dwts. gold per ton.

In the shaft immediately south of the above, quartz has been stoped south-east from the shaft over a length of 78 feet. The stoping extends from the 55ft. level to the 28ft. level and the maximum width of quartz was 3 feet. At the time of examination there was 2 feet 6 inches of quartz in the faces of the 55ft. level drive.

At the 103ft. level there is a 10ft. drive east of the shaft, and work is in progress here at present. There is a 4ft. quartz reef showing in the roof of this drive, which is cut off underfoot by a 9in. pegmatite dyke. The pegmatite has come in along a fault striking N. 30 deg. W. and dipping 55 degrees N.E. The drag of the strata on the faultplane shows that the footwall has moved east with respect to the hanging wall. If on sinking below the pegmatite the reef is not found, it should be looked for to the east.

Lady Mary, G.M.L. 24PP.—A quartz reef of very lenticular habit has been worked between the two shafts near the west boundary. The basic sediment country near the ore body has been very much disturbed.

Overhead stoping extends on the 68 foot level for a length of 20 feet south-east from the whip shaft, the maximum width being 4 feet. There is a thin quartz stringer along the roof of the 87ft. level drive off the northern of these two shafts.

P.A. (East of G.M.L. 11PP).—Lode material with quartz stringers is being worked in the main shaft at present at the 170ft. level and the owners report 6 dwts gold per ton over a width of 12 feet, the exposed length being about 55 feet.

The ore body is also exposed on the 75ft. level and here it is said to be 10 feet 6 inches wide. No stoping has yet been commenced. The basic sediment country here varies in strike from N. 10 deg. E. to N. 30 deg. W.

A 5-head battery has recently been erected on the Sunshine lease, and this will reduce the treatment costs, thereby increasing the ore reserves at this find.

MARVEL LOCH GROUP.

(East of Marvel Loch Townsite.)

This group comprises the property of the Marvel Loch Gold Development N.L., that held by the late Marvel Loch Co., G.M.Ls. 3588, 3642, 3662, 3682, 3684, and several prospecting areas.

These holdings are in an area of interbedded basic sediments, acid sediments, and basic lavas which strike north-westerly and dip steeply. The series has been intensely folded and intruded by pegmatite dykes which, in most cases, have been intruded along flatly dipping faults.

The ore bodies, with one exception, are in shears in the basic rocks and the shearing is parallel to the strike of the country. Lode material, lode material with quartz stringers, and quartz with a little lode constitute the ore bodies.

The values throughout are not very high and in some places a rise in values is noticeable with the increase of quartz in the lode material. The country is well oxidised to about 150 feet vertical depth, where the fresher and harder rock begins to appear. Secondary enrichment has taken place near the surface, and as the values here are not very high, it is advisable not to be too optimistic about the chances below water-level (250-300 feet).

Outcrops on this group are scarce, the best exposures, which may be seen west of G.M.L. 3684 and east of G.M.L. 3585, being basic sediments and lavas.

Marvel Loch Gold Development Co., N.L.—The company holds seven leases embracing an area of about 85 acres:—

- "Lubra," G.M.L. 3485 (late "Starfinch").
- "Brandizzi," G.M.L. 3430 (late "Undaunted").
- "Artesian," G.M.L. 3586 } (late "Firelight").
- "Firelight," G.M.L. 3587 }
- "Exhibition," G.M.L. 3423 (late "Exhibition" and "St. George").
- "Hill," G.M.L. 3585.
- "Bridge," G.M.L. 3521.

No work has been done on the "Hill" and "Bridge" leases. At the time of examination the company was developing the other leases and erecting the plant.

There are no rock outcrops, the formation being covered by 10 to 15 feet of red clayey soil.

Both acid and basic sediments can be seen in the underground workings. A thin band of acid sediments is encountered throughout the property in the extreme west crosscuts. Other acid sediment bands have been met with in some of the east crosscuts in the "Exhibition" lease. The remainder of the workings are in basic sediment country which is white, sometimes ironstained, kaolinitic material in the oxidised zone. The weathered rock often contains lenticular blebs of biotite which have a parallel arrangement, especially in the lode channels. Flatly dipping and vertical pegmatite dykes have been met with in the workings on the southern leases and these are a potential difficulty to mining. Some of these dykes should be met with at depth in the northern workings if they persist.

The ore bodies are mainly lode material with quartz at the south end, and, with one exception, are in basic sediment country. The exception, which is in acid sediments, is the lode on the 100ft. level from B7 shaft. On this level, it is said to be payable over a length of 90 feet and is 9 feet wide, averaging 12 dwts. gold per ton.

There appears to be three lines of lode in the basic sediments; two of these run parallel and only a short distance apart for a considerable distance and constitute the main lode. The reported length of ore is 1,200 feet over a known width of 4 feet.

The other ore body, known as the Eastern lode, is said to be payable over a length of 75 feet and a width of 60 feet.

The ore bodies have so far only been proved to 200 feet, vertical depth.

The reported estimate of the ore reserves for this property is as follows:—

Positive ore—4,620 tons assaying 12 dwts. per ton.

Ore in sight and at grass—117,540 tons, assaying 5.2 dwts. per ton.

Payable or between 100ft. and 150ft. levels and a short length between 150ft. and 200ft. levels—90,000 tons, assaying 5.2 dwts. per ton.

Total: 212,160 tons averaging 5.3 dwts. per ton.

It must not be assumed that this is the total tonnage available.

The generally accepted view is that this property is on the same line as the late Marvel Loch, but we doubt this statement; firstly, because of the marked difference in the rock types; and, secondly, on our tentative interpretation of the geological structure.

It is thought that there is probably a sharp fold in the strata near the southern boundary of the "Exhibition" lease, so that the lines of the lodes which have been recently exploited would lie somewhere east of the late Marvel Loch. However, definite evidence for this is lacking, and only further development work will clear up the point.

Marvel Loch, G.M.L. 3413.—On this lease are the main workings of the late Marvel Loch Co., which were inaccessible at the time of my visit. This prop-

erty is reported on in Bulletin 63,* since which the mine was in the hands of tributers for a short period, finally closing down in 1916. The ore bodies were in coarse-grained basic sediment country. At present the lessees are doing a little work near the north boundary.

Marvel Loch North, G.M.L. 3685.—The late Marvel Loch Co. did most of the work on this lease. The recent workings are near the north boundary, where a considerable amount of crosscutting has been done (on the 50ft. and 105ft. levels) between the three shafts. It was hoped that a continuation of the ore bodies, being developed in the Marvel Loch Gold Development Company's property, would be encountered, but investigation shows that the work was fruitless.

Alexander, G.M.L. 3642 (late Magpie).—There is renewed activity on this lease resulting from the enhanced price of gold. The owners are continuing the mining of the same ore body, which is ironstained lode material containing abundant magnetite. The ore body has already been stoped to the 55ft. level and is reported to be payable over an average width of 5 feet. An estimate of the expected stope length was not obtained.

A pegmatite dyke has just been exposed in the end of the east crosscut at the 55ft. level.

Prospecting work is in progress on the remainder of the holdings in this group, but there has been no outstanding success. Further information on these will be to hand at a later date.

XANTIPPE GROUP.

There were no existing leases or prospecting areas here at the time of my visit, and from the extent of the old workings, it appears that prospects were not very promising. None of the workings was accessible.

This group is situated in an area of interbedded basic and acid sediments which have a north-westerly strike and a steep dip. The country grades off into acid sediments eastward and into basic sediments westward.

The main workings are in acid sediments and are reported to be prospecting efforts on low grade lodes.

DONOVAN'S FIND.

This find is situated about 3 miles south-easterly from Marvel Loch, in an area of interbedded basic and acid sediments which strike north-westerly and dip steeply.

The majority of the ore bodies are granitic quartz reefs with lenticular habit, in drag folds in basic sediment country, but there are instances of quartz reefs which strike across the country, and these are in tension cracks. Also, lode material is being mined in a few places. Property-holders find treatment for their ore at Howlett's battery which is erected on the original find.

There is a paucity of rock outcrops, most of the area being covered by a thick overburden.

Flatly dipping pegmatite dykes which have been intruded along faults are a common feature of this group.

*G.S.W.A. Bull. 63, pp. 151-156.

Included in this group are the following leases:--

- "Bohemia" G.M.L. 3393.
- "Bohemia South" G.M.L. 3488 (no workings).
- "Bohemia East" G.M.L. 3395 (no workings).
- "Bohemia North" G.M.L. 3396 (no work being done).
- "Francis Furness" G.M.L. 3724.
- "Salvation" G.M.L. 3382.
- "Salvation North" G.M.L. 3410 (no work being done).
- "New Democrat" G.M.L. 3491.
- "Outsider" G.M.L. 3492.
- "Outsider No. 2" G.M.L. 3639 (no work being done).
- "Mussolini" G.M.L. 3434.
- "Propatria" G.M.L. 3690.

Bohemia, G.M.L. 3393.—A quartz reef, average width 4 feet, and striking with the country, has been stoped on five levels from the surface to 215 feet vertical depth. The maximum slope length is 250 feet, and the stoping pitches south-east. At depth the quartz contains galena and other sulphides.

There are flatly dipping pegmatite dykes in the upper levels of this mine which have come in along faults which have caused displacements of the ore body. The largest dyke occurs between the 50ft. and 96ft. levels. It strikes N. 40 deg. E., dips 30 degrees N.W., and is 33 feet wide in the main shaft.

An option has recently been taken over this property and the main shaft is being deepened with the object of proving the existence of the ore body at a lower level. To the end of 1933, 5,649 tons of ore were treated for 5,218.65 fine ounces of gold, and specimens totalled 19.66 fine ounces.

Francis Furness, G.M.L. 3724.—The ore bodies on this lease are in a band of basic sediments bounded by acid sediments. No. 2 and No. 3 shafts have been reconditioned and give access to portion of the old workings. Here stoping (average width three feet) has been carried out intermittently, the major portion between shafts Nos. 2 and 3, over a maximum length of 280 feet. Two granitic quartz reefs with lenticular habit, both horizontally and vertically, and striking with the country were mined. They run parallel throughout the workings and are only a short distance apart. They are reported to come very close together in places but never meet. Where the reefs are close they have been stoped out together, and elsewhere there are parallel stopes.

The shoots are said to pitch south-east. No. 1 shaft is sunk on a recently discovered body of quartz on the south end of this line of workings. The quartz, which strikes with the country and dips steeply east, has a maximum width of 3 feet and has been mined from 26 feet vertical depth to 120 feet vertical depth below the surface over a maximum length of 80 feet.

As mentioned before, the quartz reefs are in drag folds in the country and this fact is accentuated here.

Where the dip is steep there is an appreciable width of quartz and the values are good, but where the dip flattens the quartz pinches and the values are poor.

Mr. Howlett reports that he crushed a parcel of ore from this reef at the beginning of November, 1935, 180 tons yielding 304 ounces of bullion over the plates.

At the time of my visit there was 2 feet 6 inches of quartz in the bottom of the main shaft, said to assay 1 ounce per ton. But I understand a few days later the quartz pinched to a stringer and the values decreased. However, this is a common occurrence in the ore bodies on this lease and I consider the stringer worth following.

Also lateral prospecting may be done to advantage at the south end because parallel reefs are likely to occur.

Salvation, G.M.L. 3382.—Here the ore body is a granitic quartz reef which strikes N. 60 deg. W. with the enclosing basic sediment country. The reef has an average width of 3 feet 6 inches, and has been worked out from the surface to water level (250 feet vertical depth) over a maximum length of 150 feet.

The ore body dips 70 deg. N.E. from the surface to the 100ft. level where a fault striking N. 60 deg. W. and dipping 35 deg. N.E. is encountered. Below, the reef is displaced 10 feet north-easterly and the dip has changed to 70 deg. S.W.

On the 140ft. level a thin, barren quartz vein cuts through the gold-bearing quartz; proving two ages of quartz. Sulphides are in the quartz and the adjacent country rock at the 220ft. level.

The official production figures to the end of 1926 show that 1,407 tons of ore were treated for a return of 29.8 dwts. of gold per ton.

This lease, together with the Francis Furness and Bohemia, is under option at present to the Yellow-dine Mining and Finance Company.

Propatria, G.M.L. 3690.—Lode material with quartz veins has been stoped here over an average width of three feet from the surface to 135 feet vertical depth. On the 36ft. level the slope length is 125 feet and below, the stop length is 48 feet, but three feet of lode reported to assay 8 dwts. of gold per ton is showing in the faces of the south-east drives at the 93ft. and 123ft. levels. The ore body underlies 53 degrees south-westerly but flattens to 30 degrees between the 93ft. and 123ft. levels.

A large pegmatite dyke, strike N. 10 deg. W. and dip 45 deg. W., crosses the main shaft between the 36ft. and 65ft. levels, and offshoots from it are intersected in the workings. This massive dyke causes a break in the lode and has been intruded along a post-gold fault which has been accompanied by some displacement. The faulting was of reverse type and the footwall has been displaced about 20 feet north-easterly with respect to the hanging wall.

In the south-east drives throughout the workings a thin, barren quartz vein, striking N. 70 deg. E. and dip vertical, which is post-gold, is intersected.

To the end of 1926, 696 tons of ore was taken from this mine for a return of 1.27 fine ounces of gold per ton.

Mussolini, G.M.L. 3434.—A granitic quartz reef of lenticular habit and cutting across the basic sediment country on a north-east strike and dipping 70 deg. S.E. is being mined here.

The reef has an average width of two feet and has been worked from the surface to the 220ft. level. The stoping pitches north-east and slope length near the

surface is said to be 100 feet. At depth only 20 feet of stoping has been done, but there is still three feet of quartz in the faces of the north-east drives at the 171ft. and 220ft. levels, which is reported to be payable.

The values here have never been high, and information obtained from Mr. Howlett concerning the last crushing revealed that a parcel of 46 tons was treated in November, 1935, averaging $4\frac{1}{2}$ dwts. of bullion per ton over the plates.

New Democrat, G.M.L. 3491.—There were no accessible workings on this lease, the following information being supplied by the owners.

A quartz reef, with the same strike as the basic sediment country, has been mined to the 230ft. level from close to the surface. The ore body pitches north-west and on the bottom level stoping has been done over a length of 25 feet, the quartz pinching from two feet wide to stringers at the ends of the stope. The average value of the ore is 7 dwts. of gold per ton.

In the workings nearest the east boundary of this lease, a quartz reef, striking almost at right angles to the country, has been stoped intermittently between the surface and 150 feet, over a length of about 100 feet. The reef dips 75 degrees north-easterly.

A small amount of work has been done on a short lens of quartz, average width nine inches, which occurs near the western boundary.

Outsider, G.M.L. 3492.—The main shaft is vertical for 80 feet where a quartz reef, average width two feet, striking N. 30 deg. E. and dipping 65 deg. S.E. is encountered. The shaft underlies from here to the 126ft. level and the quartz has been stoped on both sides of the shaft, the total stope

length being approximately 50 feet. The ore from the stoping is reported to have averaged 15 dwts. of gold per ton. At 131 feet, vertical depth, a 2ft. pegmatite dyke striking N. 30 deg. E. and dipping 45 deg. N.W. cuts across the shaft. The ore body is cut off sharply by the dyke and had not been located below at the time of inspection.

Indications concerning the displacement resulting from the faulting are meagre but point to normal faulting. This being the case, the extension of the ore body should be picked up by crosscutting north-west from the bottom of the main shaft.

No information was available concerning the stoping above 80 feet.

There is 20 feet of ferruginous laterite overlying the basic sediment country on this lease.

Late Mountain King Lease.—There is a prospecting area occupying the ground held by the late Mountain King.

A lens of crushed, ironstained quartz, three feet long and three feet maximum width, has recently been worked. It underlies at 55 deg. S.E. and has been taken out below the 72ft. level for 36 feet linear depth where it breaks up. The ore taken from here is reported to have averaged 18 dwts. of gold per ton.

Exploratory work at the 119ft. level exposed a similar looking body, but values are practically negligible. The owners believe their ore body has been displaced by faulting and that this is a separate body. The basic sediment country is certainly very much disturbed, and if the ore body has been displaced, the prospects of picking up the continuation are not very promising owing to its small extent.

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DIVISION V.

School of Mines of W.A.

Kalgoorlie, 7th December, 1935.

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 1935.

ENROLMENTS.

The individual enrolment during the year reached a maximum of 476, which is 146 in advance of the 1934 total, the previous best in the School records. The usual falling off occurred, but was partly compensated by the late enrolments in the second and third terms.

The Internal Combustion Engines and the Engine Driving classes were responsible for a lot of this falling off, and most of this may be attributed to the fact that, after the Machinery Department holds its examinations for Certificates of Competency, a good many of our students, having gained their competency ticket, cease to attend the School.

The Preparatory Classes are also responsible for a heavy decline in numbers, a good deal of this being due to the enrolment of boys who are not willing, or are not capable of profiting by the instruction received in these classes. The falling off in the advanced classes' attendance is comparatively low, and some portion of this decline may be attributed to the number of advanced students who obtain lucrative positions outside of Kalgoorlie, and who are, in consequence, unable to attend the School. Any of our students employed on outside mines are encouraged to continue their studies for School subjects, and there was a considerable increase this year in the number of students doing the School work externally. This is only possible, however, when the student is well advanced in his course and is capable of studying alone. The increase in the teaching staff has made it possible to hold practically all of the School classes during the year, avoiding the undesirable alternation of subjects. This will greatly benefit students proceeding to Diplomas, enabling them to obtain the necessary instruction without the loss of time which always hampered them in previous years. Owing to the demand for qualified men, the speeding up of their training should be of considerable benefit to the mining industry.

REVENUE.

The revenue for the School year has been approximately £1,000, of which £400 consists of fees received for the conduct of Metallurgical Investigations. In addition to the above sum, the self-supporting class in Internal Combustion Engines returned fees amounting to £113.

STAFF.

Dr. B. H. Moore, Principal of the School, commenced his long service leave early in June, and is making an extensive tour of Europe and America. During his travels he intends to inspect various mining schools in England and America, and to inquire into their teaching methods. Such inquiries should prove valuable to the School and will enable comparisons to be made with similar institutions in other countries.

At the beginning of the year Mr. C. H. Warman, A.W.A.S.M., was appointed to the newly created position of Assistant Lecturer in Engineering. Mr. Warman is an engineering graduate of this School and has had several years' experience as a member of the Lake View and Star G.M. engineering staff. He has conducted the various classes in Engineering subjects with entire satisfaction to the students and to the School.

A second permanent appointment to the teaching staff was made in May, when Mr. H. Charlton Dod, B.Sc., was appointed to the position of Lecturer in Chemistry, Metallurgy and Assaying. Mr. Dod has had considerable practical experience in these branches. He was appointed to conduct classes in the above subjects, with Dr. Moore remaining as head of the department. The permanent appointment was rendered necessary by the large increase in the administrative duties both with regard to the School and to the Metallurgical Laboratory, together with the demand for ore investigations calling for additional research work on this subject. Since most of this extra work falls on Dr. Moore's shoulders, it is necessary that he should be free to devote his whole time to these important matters.

During the year a cadet was appointed to assist the lecturers with their apparatus, together with other work about the School. This appointment has been very useful and enables Lecturers to devote more time to reconditioning their laboratory apparatus, a very necessary task if instruments are to be kept in good order.

The part-time instructors, Messrs. R. Lawson (Elementary Mathematics), A. R. E. Bosustow (Internal Combustion Engines), W. J. Troup (Fitting and Turning), and J. B. McNeill (Engine Driving), have had very large classes to deal with this year and have carried out their duties in a very satisfactory manner.

PUBLIC ASSAY DEPARTMENT.

The assistance offered to prospectors has again been freely used during the year. The number of free assays and mineral determinations carried out for prospectors has been as follows:—

Assays for gold	1,524
Assays for other metals	13
Mineral determinations	160
Total	1,697

Many requests for assistance and advice have been received from prospectors all over the State. The advice tendered comprised information on all branches of mining. Every effort is made by the staff, particularly the Lecturer in Geology, to give the most complete answers to these inquiries, enabling many prospectors, battery owners and cyanide operators to carry out their operations in a more efficient and economical manner.

METALLURGICAL LABORATORY.

The negotiations that had been proceeding in 1934 between Sir David Rivett, the Chief Executive Officer of the Council for Scientific and Industrial Research, and the Mines Department for the purpose of evolving a scheme of assistance by which the equipment of the Laboratory could be increased and the scope of the work extended, was brought to fruition early in the year with the result that a complete continuous grinding and filtration unit has been purchased and installed. Other additions to the equipment consist of an oil fired assay furnace, rotap grading machine, Kinetic elutriator and Fagergren flotation cell. The assay office and chemical laboratory for the use of the metallurgical laboratory staff are now housed in a portion of the School buildings apart from that used by the students of the School.

These alterations and additions to the plant have resulted in increased efficiency and despatch in the conduct of investigations.

At the suggestion of the Mining Advisory Committee of the Council for Scientific and Industrial Research a local advisory committee has been appointed consisting of the State Mining Engineer (Chairman) and Messrs. C. E. Blackett and F. G. Brinsden to collaborate with the Officer in Charge in the work of the Laboratory.

During the past year 48 applications for investigations have been received, of which three were cancelled. Forty-two investigations have been completed and reports thereon have been issued to the parties concerned. The demand for work of this kind shows no sign of diminishing, and the confidence of mining companies in the work carried out at the Laboratory is reflected in the number of treatment plants, now in course of erection at various centres, that are based on the schemes of treatment worked out by the staff of the Laboratory.

Fees charged for investigations carried out during the year totalled £399 19s.

In connection with the Metallurgical Laboratory investigations the number of assays and chemical determinations carried out during the year has been as follows:—

Assay for gold	1,444
Chemical determinations apart from KCN and CaO deter- minations	380
Total	1,824

The Lecturer in Geology has again rendered valuable assistance to the Metallurgical Staff in the determination of the mineral character of ores submitted for investigation.

Technical Library.

Under the scheme of assistance by the Council for Scientific and Industrial Research the nucleus of a technical library has been established by the purchase of a number of modern text books on chemistry, gold metallurgy and allied subjects. This will remove the handicap of the lack of up-to-date technical literature under which the staff has had to carry on for a number of years. The library, which is available to the mining public, is under the control of the Registrar.

Metallurgical Staff.

The Staff of the Metallurgical Laboratory was increased this year by the appointment by the Department of an Assayer to replace the cadet formerly employed, and by the appointment of an Assistant Research Officer and part-time typiste by the Council for Scientific and Industrial Research. The Officer in Charge of the Laboratory, Dr. Moore, left Kalgoolie early in June on long service leave. Dr. Moore's duties were taken over by Mr. W. G. Clarke, Senior Research Metallurgist, in addition to his own.

The Metallurgical Staff has had an exceedingly busy year in carrying out the investigations that have been called for, the number of completed investigations being a record for one year's work since the Laboratory was established.

Students' Association.—Owing to the record enrolment of students and to the membership of the Association being compulsory, there has been a considerable increase in the activities of this body. This takes the form of promoting the social and sporting side of the School. For the first time in many years there is a cricket team carrying the School colours in grade cricket.

During the year the Association, assisted by the staff, conducted a public demonstration of work at the School. This was largely attended, and the funds for the Jubilee Youth and Motherhood Appeal were benefited to the extent of £27. The demonstration enabled the public to see the students at work and created a great deal of interest in the work of the School.

Technical Library.—There has been a strong demand for a technical library on the Goldfields, where standard works on the various branches of Mining, Engineering and Metallurgy would be available for consultation by interested persons. The Council for Scientific and Industrial Research made a grant for the purchase of books on the metallurgy of gold.

Using these books as a nucleus, a library was started, and a large number of books and periodicals belonging to the School were added, increasing the range of the collection. Our thanks are due to the following bodies for contributions made to the library:—Chamber of Mines, Institute of Mining and Metallurgy, Institute of Mining Surveyors, Institute of Engineers of Australia and Kalgoorlie Mechanics' Institute. The books contributed by these societies will greatly enhance the value of the library, and it is hoped that additional new books will be provided in order to bring it quite up to date. The Registrar has been appointed Librarian. The library is constantly being used by students and others and will undoubtedly serve a very useful purpose.

Buildings.—Some change has been made in the building containing the Mechanical and Electrical Laboratories and Fitting Shop. Portion of this building was altered to provide a chemical laboratory for the Metallurgical Laboratory and to house their oil-fired assay furnace. Additional alterations are necessary to enable the new Diesel engine to be installed and to provide adequate space for students in the engine room.

Equipment.—During the year the equipment of the School has been severely taxed by the large number of students attending.

For a number of years there has been little money available for new equipment, and a lot of that now being used could, with advantage, be replaced or supplemented by more modern types. During the year the School has been able to obtain approval for the purchase of some essential equipment; a part of this is not yet to hand but will be ready for use next year. We were fortunate in being able to borrow some surveying instruments from the mining companies, which enabled us to deal with the large number of students doing the Surveying Courses. An instrument that is badly needed is an epidiascope, and a grant has been made for the purchase of one. There are few important mining schools without one or more of these instruments.

A small Lister Diesel engine was purchased out of surplus funds from the Internal Combustion Engine Class. The engine will enable students to get practical demonstrations on this type of engine, and this is much appreciated by them.

Some additional expenditure is necessary on recent books and some additional periodicals, so that the teaching staff may be kept in touch with modern

practice. Some years ago we were asked to reduce the number of periodicals received, and some of those cut out at that time could perhaps be supplied to us again.

Correspondence Classes.—There have been numerous requests from persons residing outside Kalgoorlie for some form of instruction by correspondence in various branches of mining. The most we can do for many of these applicants is to suggest a course for reading. When, however, the applicant has had previous training, he is able to do some school subjects as an external student. It is certain that there are many men outside Kalgoorlie who are anxious to improve their knowledge on the technical side of mining and it is regretted that so many prospective students should be debarred from obtaining the technical training desired.

Employment of Students.—There has been no difficulty in finding good positions for our students when they are sufficiently trained; the demand for qualified men exceeds the supply at present.

Many of our old students are holding important executive positions with various mining companies and their success is very gratifying to the teaching staff of the school. A fair number of students have accepted lucrative positions outside of Kalgoorlie and are unable to continue attending the School. When possible these students are encouraged to go on with their school work as external students to complete the course. It seems that the demand for qualified men must continue and that there will be no difficulty in finding employment for our students for some considerable time. Applications are usually called from the office for any vacant positions and the mining companies are generally quite satisfied with the men we send them. In many cases the best students refuse the offer, in which case the best man obtainable is sent.

I would like to record our appreciation of the assistance accorded to the School by the mine managements and ex-students in this direction.

In conclusion, it is my duty to express my appreciation of the work done by each member of the staff during the past year. A great deal of the success we have experienced this year has been due to their zealous work and to their endeavours to assist the students in every way.

C. MEREDYTH,
Acting Principal, School of Mines.

DIVISION VI.

Annual Report of the Chief Inspector of Machinery, Inspection of Machinery Branch of the Mines Department, for the Year 1935.

The Under Secretary for Mines.

For the information of the Hon. Minister, I am submitting herewith 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, 1935.

The work of this Branch is still increasing, and again has exceeded that of all previous years, the greatest increase being shown in the work of the Board of Examiners for Engine-drivers. The number of accidents to persons showed an increase of 11 over the year 1934, but is only 4 more than 1933. The fatal accidents were two, which is one less than in the previous year.

The financial position has again improved, and resulted in a credit balance of £2,071 5s.

RICHARD C. WILSON,
Chief Inspector of Machinery.

18th May, 1936.

To the Chief Inspector of Machinery.

Sir,

I have the honour to submit for the information of the Hon. Minister for Mines the following report on the operations of "The Inspection of Machinery Act, 1921," in the districts proclaimed thereunder, together with statistical tables for the year ended 31st December, 1935.

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

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

DIVISION I.

Inspection of Boilers.

The total number of registered boilers, including various types of unfired pressure vessels, such as steam jacketed pans, digesters, vulcanisers, air and gas receivers, etc., which were fit for use according to records, was 3,969 on 31st December, 1935, compared with 3,878 on 31st December, 1934, making a net increase of 91.

There were 108 boilers added to the register during 1935, including 1 boiler previously condemned which was found to be worth repairing, 2 which were temporarily under the jurisdiction of other State Departments were transferred back, and 105 new registrations. Of these latter, 27 were imported from the United Kingdom, 1 from United States of America, 14 from other Australian States, 20 the origin of which has not been traced, and 43 built in Western Australia. The proportion of new registrations which were built in Western Australia was 41 per cent. compared with 33 per cent. in 1934 and 14 per cent. in 1933. The types built locally were:— 1 Vertical Portable, 5 Return Multitubular Stationary Underfired, 11 Locomotive Portable Rectangular Fire-box, 2 Digesters, 20 Air Receivers, 1 Steam Jacketed Vessel and 3 Vulcanisers.

There were 17 boilers deducted from the register during 1935. Of these, 15 were condemned as unfit for further use, 1 was transferred out of this State and 1 transferred to another Department in this State.

Thorough inspections numbered 1,815, being an increase of 102 over the figures for 1934. The Goldfields districts, controlled from Kalgoorlie Office, accounted for 100 of this increase.

Working inspections for which reports were submitted amounted to 44, an increase of 23 over the year 1934. The total number of boiler certificates issued was 1,827 in 1935, compared with 1,727 in 1934, an increase of 100 over the whole State, but a decrease of 7 in districts worked from Perth and an increase of 107 in districts worked from Kalgoorlie.

Repair notices issued numbered 427 or 9 less than in 1934.

Return No. 1—Showing Operations in Proclaimed Districts during year ended 31st December, 1935.

(BOILERS ONLY.)

	Districts worked from Perth.	Districts worked from Kal-goorlie.	Unpro-claimed Area.	Totals.	
				1935.	1934.
Total number of useful boilers registered ...	2,636	1,292	41	3,969	3,878
New boilers registered during year ...	75	30	...	105	113
Boilers reinstated ...	1	...	...	1	1
Boilers Inspected—					
Thorough ...	1,429	386	...	1,815	1,713
Working ...	35	9	...	44	21
Boilers condemned during year—					
Temporarily ...	29	2	...	31	35
Permanently ...	13	2	...	15	21
Boilers sent to other States during year ...	1	...	...	1	2
Boilers sent from other States during year ...	...	...	...	...	2
Transferred to other departments ...	1	...	...	1	2
Transferred from other departments ...	2	...	...	2	3
No. of Notices for repairs issued during year ...	357	70	...	427	436
No. of Certificates issued, including those issued under Section 30 during year ...	1,434	393	...	1,827	1,727

New Construction.

No boilers of unusual interest were imported into or constructed in this State during 1935, but it is pleasing to have been able to record in a previous paragraph that 41 per cent. of the new registrations for 1935 were built locally.

Electric arc welding is gradually increasing in scope both for new work and repairs, with a consequent reduction in cost.

Maintenance.

Unsuitable feed water was again the cause of rapid deterioration in the case of a few boilers, but owners generally are alive to the importance of good feed water, or the proper treatment of unsuitable feed water before it is fed into the boiler.

Return No. 2—Showing Classification of Various Types of useful Boilers in Proclaimed Districts on 31st December, 1935.

Types of Boilers.	Districts worked from Perth.	Districts worked from Kal-goorlie.	Unpro-claimed Areas.	Totals.	
				1935.	1934.
Lancashire ...	48	50	...	98	98
Cornish ...	219	365	...	584	588
Semi-Cornish ...	35	15	...	50	49
Vert. Stat. ...	374	285	...	659	652
" Port. ...	72	9	...	81	82
" Mult. Stat. ...	42	19	...	61	60
" Port. ...	23	3	...	26	29
" Pat. Tubular ...	8	...	...	8	8
Loco. Rect. Firebox Stat. ...	97	48	...	145	143
" " " Port. ...	277	45	...	322	311
" Circ. " " ...	145	5	...	150	149
Locomotive ...	77	41	...	118	119
Water Tube ...	114	114	...	228	230
Return Mult. Underfired Stat. ...	101	56	...	157	152
Return Mult. Underfired Port. ...	3	5	...	8	8
Return Mult. Int. Fired Stat. ...	43	5	...	48	48
Return Mult. Int. Fired Port. ...	2	...	...	2	2
Egg ended and other types not elsewhere specified ...	41	17	41	99	100
Digesters ...	85	5	...	90	89
Air Receivers ...	402	191	...	593	520
Gas Receivers ...	4	...	...	4	4
Vulcanisers ...	214	8	...	222	218
Steam Jacketed Vessels ...	210	6	...	216	219
Total registrations useful Boilers ...	2,636	1,292	41	3,969	3,878
Total boilers out of use 31st December, 1935 ...	1,202	899	...	2,101	2,079

DIVISION II.

Explosions, Interesting Defects, etc.

On 6th February, 1935, an egg-ended air receiver 14ft. 2in. overall x 4ft. 6in. diameter x $\frac{3}{8}$ in. plate exploded. The shell was made in three rings, two of which ruptured longitudinally. The centre ring failed longitudinally through the centre line of the manhole, the line of rupture continuing on through the solid plate of the next ring to nearly the circumferential seam connecting one egg end, but then the line of rupture turned abruptly at right angles in both directions, tearing the plate circumferentially for about three-quarters of the circumference. From the manhole opening the rupture also travelled in the opposite direction, but in this case turned at right angles at the circumferential seam which failed partly by shear of the rivets, and partly by rupture of the plate along the line of rivet holes, so that two rings of the shell were almost completely flattened, and one ring and both ends left practically intact. The air compressor to which this receiver was attached was a two-cylinder single stage compressor, and at the time of the accident the driver noticed that the delivery pipe was "smoking hot," but the cylinder water jacket was cool. The driver said that at the time of the explosion he was attempting to adjust the unloading device to reduce the excessive pressure.

On examination of the compressor the delivery valve of one cylinder was found not to be seating correctly, due to faulty assembly, and for some time previously the oil consumption had been very high, the air intake to the compressor being through the crankcase and a suction valve in the piston head. Certain adjustments were made which reduced the oil consumption to normal, and as a precaution an after cooler was fitted. The shade temperature at the time of the explosion was about 93 degrees.

An accident which might easily have proved fatal was caused by the ravages of teredo in the piles of a temporary jetty, which was used for the purpose of constructing a breakwater. A portable steam crane was taken out to the end of the jetty to pick up a small boiler which had been used for pile driving, and when the crane was travelling landwards carrying the boiler, some of the piles on one side of the jetty collapsed, tipping the crane with its load into about 15 feet of water. Luckily the crane driver was able to jump clear just as the crane submerged, and escaped with slight injuries to his back, shock, and the effects of immersion. The crane boiler was under steam at 80 lbs. per square inch, and when it was recovered it was found to be uninjured.

DIVISION III.

Inspection of Machinery.

The total number of groups of useful machinery registered on 31st December, 1935, was 11,435, an increase of 681 groups since 31st December, 1934. Of these, 23 were driven by steam, 210 by oil engines, 15 by gas engines, 2 by compressed air, and 431 by electric motors. The number driven by hydraulic power remained the same.

The total number of groups of machinery inspected was 8,615 for 1935, compared with 7,830 for 1934, an increase of 785, or 510 more than the increase for the previous year 1934.

There were 331 notices issued to owners for the guarding or repair of machinery during 1935, which was 17 less than the number issued during 1934.

Return No. 3.—Showing Operations in Proclaimed Districts during Year ended 31st December, 1935.

(MACHINERY ONLY.)

	Districts worked from Perth.	Districts worked from Kalgoorlie.	Totals.	
			1935.	1934.
Total registrations, useful machinery ...	9,337	2,098	11,435	10,754
Total inspections made	7,247	1,368	8,615	7,830
Certificates (bearing fees)	3,200	403	3,603	3,364
Certificates (steam, without fees) ...	242	21	263	246
No. of extension certificates issued under Section 42 of Act ...	...	...	...	...
Notices issued (machinery dangerous) ...	309	22	331	348

The fitting of duplicate electro-mechanical locks to all enclosure doors of automatic lifts is now practically complete. The Lift Code of the Standards Association of Australia is being complied with in the case of all new lifts being erected.

The total number of lifts registered at 31st December, 1935, was 263, compared with 261 at 31st December, 1934. The number of passenger lifts registered increased by four but the number of goods lifts registered decreased by two, leaving a net increase of two.

Return No. 4.—Showing Classification of Lifts on 31st December, 1935.

Type.	How Driven.	Totals.	
		1935.	1934.
Passenger ...	Electrically driven ...	145	141
	Hydraulically driven	1	1
Goods ...	Electrically driven ...	109	110
	Hydraulically driven	3	3
	Belt driven ...	5	6
		263	261

Practically every class of industry showed increased activity during the year, the mining industry and the plant necessary for the bulk handling of wheat being the two largest contributing factors to the increase in the number of machinery groups registered.

A pleasing feature of nearly all new plants is the almost entire elimination of line shafting, owing to the use of individual driving of each machine by electric motors. This should result in a reduction of the number of accidents.

Return No. 5.—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, 1935.

Classification.	Districts worked from Perth.	Districts worked from Kalgoorlie.	Totals.	
			1935.	1934.
No. of groups driven by steam engines ...	712	369	1,081	1,058
No. of groups driven by oil engines ...	1,684	311	1,995	1,785
No. of groups driven by gas engines ...	129	119	248	233
No. of groups driven by compressed air ...	8	39	47	45
No. of groups driven by electric motors ...	6,800	1,260	8,060	7,629
No. of groups driven by hydraulic pressure ...	4	...	4	4
	9,337	2,098	11,435	10,754

DIVISION IV.

Prosecutions under the Act.

Proceedings were taken against one person for acting as a winding engine-driver without being the holder of the necessary certificate. A conviction was recorded.

The number of cases in which it was necessary to invoke the aid of the Crown Law Department to collect fees was less than previous years. In the majority of cases the neglect to pay fees is due to procrastination, and as Inspectors have now been authorised to collect fees, there should be very few cases of default in future.

DIVISION V.

Accidents to Persons.

During the year 33 accidents were reported and inquired into by Inspectors, unfortunately 2 had fatal results, compared with a total of 22, which included 3 fatal, during the year 1934.

One accident which resulted in the death of the person injured, was caused through deceased's left arm being crushed between a conveyor belt and the driving pulley. There was no evidence to show how the accident happened and the injured person died nearly three weeks after the accident due to complications.

The other fatality was due to the injured person slipping after he had jumped off a slowly-moving locomotive used on a narrow gauge woodline. He fell close to the line and was injured by the cylinder drain cocks before the locomotive could be stopped. Among other injuries, he sustained a compound fracture of the left leg below the knee. His leg had to be amputated, but unfortunately he did not survive the operation, due to shock and previous loss of blood, as some considerable time elapsed before it was possible for the doctor to reach the scene of the accident.

Of the remaining accidents, 8 were due to circular saws. In six of these cases the accident was due to the injured person slipping, one through a finger-stall catching in the saw teeth, and the other to a piece of wood being caught on the back of the saw

and thrown forward, catching the operator on the forehead. He was engaged in cutting wedges, but no provision had been made to prevent them being picked up by the back of the saw.

One accident was caused by the top of scrubber being blown off when a gas producer plant was being lighted up. Unfortunately the injured person was standing on top of the gas producer at the time, and was injured by the coke which was blown out of the scrubber, causing loss of sight to one eye. On some plants similar explosions have occurred previously, but without injury to any person, and many scrubbers have been fitted with an explosion door, or water seal on the top of the scrubber, which prevents serious damage.

Return No. 6.—Showing Persons Killed or Injured by Boiler and Machinery Accidents in Proclaimed Districts during Year ended 31st December, 1935.

Numbers within parentheses denote fatal accidents.

Class of Machinery.	Districts worked from Perth.	Districts worked from Kalgoorlie.	Total.
Metal Working—			
Lathe ... ..	...	1	1
Drilling Machine ... ..	...	1	1
Punching Machine ... ..	...	1	1
Planing Machine ... ..	...	1	1
Sawmilling and Woodworking—			
Circular Saw	4	4	8
Buzzer	3	...	3
Sticker	1	...	1
General—			
Ore Conveyor ... ..	...	2 (1)	2 (1)
Belting ... ..	...	3	3
Cutting Machine	1	...	1
Caramel Roller	1	...	1
Stone Crusher	1	...	1
Pumps	1	...	1
Printing Machine	1	...	1
Power Press	1	...	1
Textile Machine	1	...	1
Locomotive ... ..	...	1 (1)	1 (1)
Suction Gas Producer ... ..	...	1	1
Ore Classifier ... ..	...	1	1
Explosions (Air Receiver) ... ..	...	1	1
Winding Engine ... ..	...	1	1
	15	18 (2)	33 (2)

DIVISION VI.

Engine-drivers' Examinations and Kindred Matters.

The total number of certificates granted during the year was 646, compared with 364 granted during the year 1934, an increase of 282, and 57 more than the combined total granted in 1934 and 1933. In spite of this marked increase there is still a shortage of winding engine-drivers. There were 42 certificates of winding competency granted during 1935, 19 during 1934 and 5 during 1933.

Examinations were held as follows:—Perth 4, Kalgoorlie 3, Leonora 2, Cue 2, Meekatharra 2, and Bunbury 2. Examinations were held at all advertised centres except Geraldton.

The Board of Examiners were occupied for 47 days in Perth dealing with applications for competency certificates, correcting examination papers

and other matters connected with engine-drivers. The Travelling Board spent 21 days conducting examinations and a further 36 days in travelling and making inquiries.

A total of 748 applications were received and considered by the Board, compared with 405 during 1934, an increase of 343 and 72 more than the combined total for 1934 and 1933.

Complaints and Inquiries, etc.

There was one prosecution previously mentioned, and there were five complaints regarding the employment of persons who were not the holders of the necessary certificate. These complaints were duly investigated and settled satisfactorily.

The personnel of the Board of Examiners remained unchanged.

Return No. 7.—Showing Total Number of Engine-drivers and Boiler Attendants' Certificates (all Classes) Granted in 1935, compared with 1934.

	Number Granted.	
	1935.	1934.
Winding Competency including Certificates issued under Regulation 40 and Section 60 of Act	42	19
First Class Competency, including Certificates issued under Regulations 40 and 45 and Sections 60 and 65 of Act	26	29
Second Class Competency, including Certificates issued under Regulation 40 and Section 60 of Act	64	31
Third Class Competency, including Certificates issued under Regulation 45 and Sections 60 and 63 of Act	135	30
Locomotive Competency	10	16
Traction Competency	5	...
Internal Combustion Competency	121	67
Crane and Hoist Competency	14	9
Boiler Attendant Competency	207	143
Interim	5	6
Copies	6	8
Transfer	11	6
Totals	646	364

DIVISION VII.

General, Staff, Mileage.

It was not possible to have any amendments made to the Inspection of Machinery Act during the year 1935, but several amendments were made in the Regulations relating to lifts and hoists to bring them into line with the Standards Association of Australia Lift Code, and amendments were also made in the Regulations relating to the granting of certificates to Engine-drivers, etc., chiefly with a view to reducing the time necessary to qualify for a winding engine-driver's certificate of competency. This was found necessary owing to the acute shortage of winding engine-drivers.

About the usual amount of work was undertaken on behalf of other Government Departments, chiefly in regard to the inspection of and valuing boilers and machinery.

Inspectorial Staff.

Two new Inspectors were appointed during the year, one in February and the other in November. Inspector Jordan was appointed Senior Inspector

and took up his duties in December, and Inspector MacGregor was transferred to Kalgoorlie in his place as Inspector-in-Charge of the Kalgoorlie district.

Clerical Staff.

The clerical staff remained unchanged.

Mileage.

The total mileage travelled in the various districts during the year 1935 was 57,436, compared with 52,659 for the year 1934, an increase of 4,777 miles.

The total mileage was made up as follows:—2,489 miles by rail, a decrease of 3,170 miles; 54,885 miles by road, an increase of 12,266; 62 miles by water, a decrease of 4,319. The decrease of rail travel was due to fewer special inspections being required in country districts, which could be conveniently reached by rail, and the decrease in water mileage was due to Wyndham not being visited during 1935. The increased road mileage is much less than one would expect from the increased number of inspections. The average miles per inspection were 5.48 or decrease of .02 miles per inspection.

Return No. 8.—Showing Distances Travelled, Number of Inspections Made and Average Miles Travelled per Inspection for Year ended 31st December, 1935.

—	Rail Miles.			Road Miles.			Water Miles.			Total Miles.			Total Number Inspections.			Average Miles per Inspection.			
	1935.	As compared with 1934.		1935.	As compared with 1934.		1935.	As compared with 1934.		1935.	As compared with 1934.		1935.	As compared with 1934.		1935.	As compared with 1934.		
		Increase.	Decrease.		Increase.	Decrease.		Increase.	Decrease.		Increase.	Decrease.		Increase.	Decrease.				
Districts worked from Perth ...	1,328	...	3,557	40,884	8,302	...	62	...	4,319	42,274	426	...	8,711	196	...	4.85	...	.06
Districts worked from Kalgoorlie	1,161	387	...	14,001	3,964	...	...	...	...	15,168	4,351	...	1,763	714	...	8.60	...	1.70
Totals ...	2,489	387	3,557	54,885	12,266	...	62	...	4,319	57,436	4,777	...	10,474	910	...	5.48	= Average all Districts, 1935.		
Increases or Decreases ...	...	Decrease 3,170		...	Increase 12,266		...	Decrease 4,319		...	Increase 4,777		...	Increase 910		...	Average all Districts, 1934.	
																		Average Decrease .02 miles per inspection.	

DIVISION VIII.

Revenue and Expenditure.

Revenue increased by £1,057 13s., each item except incidentals showing an increase, but expenditure also

increased by £897 17s. 4d., each item being higher than for 1934. But in spite of the increased expenditure the year's work resulted in a credit balance of £2,071 5s., compared with £1,911 9s. 4d. at the end of the year 1934.

Return No. 9.—Showing Revenue and Expenditure for Year ended 31st December, 1935.

REVENUE.				EXPENDITURE.					
—	1935.		1934.		—	1935.		1934.	
	£	s. d.	£	s. d.		£	s. d.	£	s. d.
Fees for Boiler Inspections. ...	2,739	14 5	2,557	6 0	Salaries	4,256	0 0	3,735	15 4
Fees for Machinery Inspections ...	4,166	3 1	3,648	16 7	Incidentals	1,281	8 9	1,031	3 4
Engine-drivers' Fees	847	18 0	467	13 0	Engine-drivers	215	12 11	88	5 8
Incidentals	70	11 2	92	18 1					
Increase—£1,057 13s. 0d. ...	7,824	6 8	6,766	13 8	Increase—£897 17s. 4d. ...	5,753	1 8	4,855	4 4

Profit—£2,071 5s. 0d.

In presenting the annual report for what has proved to be a most successful year, I wish to tender my thanks to all those whose co-operation helped in achieving this result. Very valuable assistance has been rendered by many Government officers of both this State and the Commonwealth.

The good feeling among the officers of this branch has continued and has rendered possible the results

attained, and I wish to thank them for their good work during the year.

G. MOORE,
Deputy Chief Inspector of Machinery.

18th May, 1936.

DIVISION VII.

Annual Report of the Chemical Branch, Mines Department, for the Year 1935.

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 1935.

STAFF AND EQUIPMENT.

Owing to resignations and retirements considerable changes took place in the staff during the year. There was such an abnormal incidence of ill-health on the staff that a request has been made that the Commissioner of Public Health should investigate the conditions under which our work has to be performed. It is evident that the present site and surroundings have become totally unfitted for working in an atmosphere daily charged with such poisonous gases as hydrogen fluoride, hydrogen sulphide, methylene iodide, unsaturated hydrocarbons, etc. The laboratory is on the lee side of the centre of the city, and the ridge on which the city is built, and by degrees it has been so surrounded by high walls and buildings at a distance of only a few feet, that it is impossible to get a free play of air through it to dilute the fumes and drive them out of the building quickly.

The staff is still greatly hampered owing to the failure to keep the equipment up to date over the depression years. As pointed out last year the condition of the library is particularly unsatisfactory, being in several respects so out of date that we hesitate to give advice on many problems submitted to us. To a chemist, as to many other professional men, books are as much "tools of trade" as saws and hammers are to a carpenter. A committee representing the Carnegie Endowment has criticised very adversely the condition of public and official libraries almost throughout Australia.

Conditions in the furnace room have deteriorated to a point at which complete renovation is urgently necessary. For economy and speed in manipulation the new equipment should be designed to burn oil fuel instead of coke and charcoal. Pending this renovation, we are losing a considerable amount of revenue.

Our spectrographic equipment is out of date and needs to be supplemented considerably so that it can be used in solving obscure problems of animal nutrition and metallurgy. For this the necessary technique has been acquired recently by one of my staff, Mr. F. E. Chapman, A.A.C.I., in England, Holland and Germany. An ultra-violet lamp is also badly needed.

NATURE OF WORK DONE.

No brief or statistical account can be given of the many chemical and physical problems we are asked by Government Departments and the general public to give advice on. They ranged from how to make a mine water suitable for cooling a Diesel engine, or what is the best local clay for a certain manufacture to why certain pine plantations are not flourishing, or how can anaesthetic ether be prevented from deteriorating, or what is the feeding value of an obscure native plant, or how to make brass polish, or what is the latest book on precious stones, etc., etc.

Only when a definite physical or chemical determination is required in connection with a concrete sample submitted, can it be registered and numbered, and dealt with statistically. The total number of samples registered in this way during the year was 7,160. The number of individual determinations required is of course largely in excess of the number of samples. The samples received have been classified in the following table:—

TABLE SHOWING SOURCE AND ALLOCATION OF SAMPLES.

Source. Department, etc.	Section 1. Foods, Drugs and Toxicology.	Section 2. Mineralogy and Geo- chemistry.	Section 3. Agriculture and Water Supply.
Premiers	2	2	...
Mines—State Batteries	11	1,221	... 1
State Mining Engineer	3	247	...
Government Geologist ... ..	...	85	... 4
Government Laboratory	27	41	6
Explosives	19	...	...
Health—Commissioner Public Health	191	...	10
Perth Hospital	31	...	...
Agriculture	67	1	951
Works—General	26	...	118
Metropolitan Water Supply	7	4	267
Treasury—Government Stores	185	11	3
Police: Criminal Branch	124	2	...
Liquors Inspection	23	...	...
Forests	78	...	156
Lands ... ..	...	...	1
Chief Secretary	6	...	2
Education	2	...	...
Miscellaneous	1	...	2
Public Pay	48	2,139	305
Public Free	13	712	5
Totals	864	4,465	1,831
Grand Total ... ..	...	7,160	...

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

Foods, Drugs and Toxicology.

Human poisoning exhibits	135
Tan barks	83
Milk, human	50
Milk, bovine	44
Anaesthetic ether	42

Mineralogy and Geochemistry.

Gold ores and tailings	4,034
Minerals for determination and valuation	274
Weights for standardisation	69
Limes (burnt) for assay	49
Copper ores for assay	30

Agriculture, Water Supply and Sewerage.

Soils for analysis and pH	730
Waters, complete and partial analysis	623
Wheat, milling, etc.	91
Flour	90
Sewage	69

Foods and Condiments.

Some check is kept on the quality of foods sold in the metropolitan area through samples received with tenders or under contract by the Government Tender Board, and through samples collected by health inspectors. A few samples also are examined on private account. Short weight has not been observed to the same extent as last year, but was recorded in samples of the following:—Jam, custard powder, metal polish, soap and soap extract, tinned tomatoes and vinegar. What amounts in practice to the same thing, viz., a shortage in the percentage of the most valuable constituent of a mixture, was observed in several other cases, *e.g.*, essences and jelly crystals.

The most unsatisfactory line on the market under this heading continues to be vinegar, imitations of true vinegar being camouflaged in various ways to lead the unsuspecting purchaser into believing he is purchasing the genuine article. Several of the tomato sauces examined were very unsatisfactory, being watery mixtures thickened with starch, or adulterated with apple pulp, aniline dye, and undeclared preservatives. The lack of discrimination on the part of many purchasers is responsible to some extent for the growth and maintenance of such practices.

Referring to the table of foodstuffs given by Mr. Hill on page 97, the proportion of samples below standard, viz., 47 per cent., would be appalling if the samples dealt with represented a fair average of all items of our food supply, and not merely to a large extent a sampling of materials already suspect. Even so, however, the proportion is far too high when compared with a general average of 5.3 per cent. in England.

Some interesting facts regarding the so-called "protein" and "slimming" breads will be found in Mr. Hill's report on page 98.

Beverages.

The only artificial beverages examined during the year were three samples of hop beer, seven of beer, one each of soda water and rum, two each of brandy and gin, five each of whisky and wine. Three of the wines contained saccharin contrary to the Health Act regulations, and four samples of spirits were either below strength or not true to label.

Fifty samples of human milk and 44 of bovine milk were analysed, the former being done for various Infant Welfare Clinics in cases where infants were showing subnormal development. Of the bovine milks, 30 per cent. were below standard. The small number analysed by this Department is due to the

fact that many hundreds of samples are regularly analysed in the Local Health Board's laboratory and that of the Whole Milk Board.

During the year authority was sought to manufacture and sell soda-water, lemonade, etc., charged with nitrous oxide instead of carbon dioxide. The true significance of this was pointed out and the project promptly nipped in the bud.

Metropolitan and Goldfields Water Supplies.

The advisory committee on the metropolitan water supply has had regular monthly meetings and kept a close watch on the sources of supply and the quality of the water actually delivered in the city. An officer of this Branch frequently accompanies one of the water supply engineers to check conditions at the sources of supply and collect samples for laboratory investigation. The water supplied shows a marked improvement over that of previous years owing to the utilisation for the first time of water from the new Canning reservoir and the steady substitution of cement lined for unlined pipes.

The goldfields water supply continues to be satisfactory except temporarily in small areas newly connected with the main by cement or cement-lined pipes. This results in a temporary rise of pH to 10 to 13 units, a figure not only indicative of unpalatability, but also threatening to create digestive troubles when drunk. A steady flow of water through the pipes soon rectifies this condition by removing the soluble caustic lime from the surface layer of cement.

Various local supplies for country towns, particularly Geraldton and Albany, have also been under review. The chief trouble at the former is a rise in salinity during summer, and at the latter a brown peaty discoloration at times.

Sewerage Problems.

The Perth sewerage system is undergoing extensive changes, including a change-over from septic tank and filter bed treatment followed by discharge into the river to an ocean discharge preceded by separation and digestion of solids. Close chemical control is required at every stage if successful results are to be obtained, and one of my staff has been in close touch with the engineer throughout the year.

To guard against any possible pollution of the popular surfing beaches along the coast, the first of a series of pollution surveys of the ocean water near the discharge was carried out during the year. This involved a determination of phosphorus, nitrogen and oxygen absorption in a number of sea waters taken over a fan-shaped area surrounding the ocean outfall. The first results were highly satisfactory, indicating a total absence of solid pollution and a liquid pollution quite undetectable at a distance of a few hundred yards.

Drugs.

The drug mainly investigated was anaesthetic ether, which in our warm climate has been found to develop an undesirable proportion of peroxides once it is exposed to the air, by opening containers and decanting supplies. No cure for this condition once it has developed has been discovered but it was

found possible to prevent its development by placing in the container, immediately it is opened, a coil of clean, bright, copper gauze.

Toxicology.—One hundred and thirty-five samples of human viscera, urine, etc., were submitted for examination in connection with 57 cases of poisoning. None of these were murders, almost all being cases of suicide, of which a number were not fatal. Several were of peculiar nature, and are detailed in Mr. Hill's report.

There were two cases of accidental death of children who had unwittingly swallowed, in one case, a fragment of cyanide which had been dropped; in another case a number of pills containing a small proportion of strychnine, of which merely a medicinal dose for an adult was contained in each pill.

One notable case of cattle poisoning was traced to ammonium sulphate having been given to the animal as a drench in mistake for magnesium sulphate. The poisonous nature of the former is not as widely known as it should be, considering its extensive use as a fertiliser.

Tanning Materials.—The whole of the 83 barks examined were derived from eucalypts, chiefly the different species of "mallet." Of these 38 were "brown mallet" (*E. astringens*), one sample of which yielded 59 per cent. of tannin, nine others over 45 per cent., and 12 between 40 and 45. Of the other eucalypts only one other, a wandoo (*E. redunca* var. *E. elata*) yielded over 45 per cent.; and two others, "blue mallet" (*E. Gardneri*) and "*E. redunca*," between 40 and 45 per cent.

Wide variations in tannin content were noted in samples of bark of the same species from different localities.

During the year a factory for the manufacture of concentrated tannin extract was opened in Perth.

Farm Waters.—Owing to the dry season experienced in many farming areas a constant stream of waters from dams, wells, and new shallow bores were submitted for the determination of their salinity. Many of them were too saline for watering sheep, and still more for watering farm horses, which are found to tolerate no more than 450 grains of soluble salts per gallon when working on dry feed. Where, however, a remnant of comparatively fresh dam water is available, it can be eked out by mixing with it a carefully calculated amount of much more saline well water, and many farmers have been advised to do this.

Wheat and Wheat Products.—These occupied the attention of our cereal chemist and other officers of the Agricultural Section over a large part of the year. As usual, after a preliminary selection by the judges, 55 wheats were milled and otherwise examined in connection with the competitive entries in the Royal Agricultural Show.

From the State Experimental Farms 31 wheats were examined and milled, and the flour from them tested in detail. These figures are essential data in the breeding of new wheats, and in tracing the effects of climate, soil, and systems of fertilisation on established varieties.

As in previous years comparative milling tests and chemical and physical examinations were made of certified samples of f.a.g. export wheat from the four chief producing States. The results will be found in Mr. Hoare's report on page 104.

Pine Plantations.—Research was continued into the causes of healthy and stunted growth in the State pine plantations. This involved a large number of soil analyses as well as analyses of the bark and needles of a number of pine trees. Some preliminary spectrographic work was done by Mr. F. E. Chapman, on the ashes of pine needles, in the laboratory of Adam Hilger & Co. in London. It is hoped to continue this method of investigation when our spectrographic equipment has been brought up to date, as it is probable that investigations by this method will disclose either some tonic element in the healthiest pines, or some toxic element in the unthrifty.

Fertilisers.—The number of fertiliser samples submitted this year was less than in 1933 or 1934. Five out of 29 samples failed in some respect to comply with the Act. The superphosphate manufactured at the five principal factories proved to be of standard quality whenever checked.

Soils.—The number of soil samples analysed in recent years has been:—

1931	..	..	619 samples.
1932	..	..	503 "
1933	..	..	1,139 "
1934	..	..	633 "
1935	..	..	730 "

As time goes on it should become possible to summarise the results in a way that will give a broad view of the nature of the soils in the different climatic regions of the State. Up to the present it has only been possible to describe in general terms the soils of restricted areas such as Dartmoor, Carnarvon, etc.

Gold Assays.—Over 4,000 gold assays were made of ores and tailings, a record far surpassing any previous one. The samples were mainly (1) bore cores for new mining companies, (2) grab samples for individual prospectors, (3) tailings from the State batteries. A severe strain was put upon the crushing plant, furnaces and assay staff. The last is now satisfactorily protected against the risk of silicosis by housing the fine grinding machine and connecting an exhaust fan to it.

Incidentally, the bore cores obtained from depths of many hundreds of feet gave us a valuable insight into the true nature and origin of many important gold veins, and emphasised the wide variations in type of rock included under the general term "Archaean greenstone." It also proved that some at least of the innumerable "jasper bars" outcropping on the surface persist to great depths as banded quartz-magnetite rocks. Notable examples of this were disclosed by boring at Jimblebah, Mt. Magnet and Retaliation.

The most interesting gold ore examined was that of the Big Bell (Premier) gold mine at Coodardy, which was exhaustively sampled at the 250ft. level by the State Mining Engineer, whilst bore cores have been examined from slightly greater depths. The lode is a 60ft. bed of quartz-felspar-muscovite schist traversed by many small veins of quartz, and albite-

microcline pegmatite. The ore carries an average of 3.51 dwts. of gold per ton with 6.60 per cent. of pyrite, 0.15 per cent. of stibnite, and only traces of arsenopyrite, blende, chalcopyrite, galena and molybdenite. Small needles of tourmaline are present in almost every sample of it.

Mineral Determinations.

One of the most useful functions of the Mineral Section is the accurate classification of minerals discovered by prospectors or suspected by mine managers to be influencing their extraction. By this means useful advice has often been given in regard to metallurgical treatment, and the occurrence of minerals of commercial value new to the State has been revealed, and finders put in touch with probable markets.

Noteworthy minerals examined during the year were:—

Bismutospherite, Talga. Carbonate of bismuth. An alluvial boulder of this valuable bismuth ore weighing several pounds was found associated with tantalite, both evidently shed from a near-by pegmatite vein.

Fayalite, Burges Find near Burracoppin. Silicate of iron. This mineral was proved to be one of the more important constituents of a gabbro dyke. First record for this State.

Gahnite, Lower Chittering. Oxide of aluminium and zinc. Numerous small green crystals found as an impregnation in sillimanite-quartzite at Goyamin Pool.

Grossularite, Toodyay. Silicate of calcium and aluminium. This garnet was found to form about 70 per cent. of a hornstone in a series of Precambrian sediments.

Laumontite, Comet Vale. Hydrated silicate of calcium and aluminium. Forms a small vein in a bore core. First record for this State.

Montebrasite, Ravensthorpe and Ubini. Hydroxyphosphate of lithium and aluminium. This mineral, which is of value as a source of lithium compounds, occurs in pegmatite veins. First record for this State.

Pisanite, Ravensthorpe. Hydrated sulphate of copper and iron. Found in old copper workings. First record for this State.

Tennantite, Palmer's Find. Sulpharsenite of copper. Some of the richest auriferous quartz from here was found to carry a fair amount of tennantite and arsenopyrite, with a little blende and chalcopyrite.

Other noteworthy mineral discoveries are referred to by Mr. Bowley in his report on page 102.

Lime.

Lime is such an extremely important material for a wide range of industries that every effort has been made during the last few years to raise the quality of the product on the Perth market, which up till five years ago was mostly of very low and variable grade. Every opportunity has been taken of meeting and advising lime-burners, and pressure has been brought to bear upon them by framing specifications for higher grade lime for use, first in the Metropolitan Water Supply, and later in State batteries, Government buildings, etc. The analyses of samples of

the lime now supplied to various Government departments show a very gratifying response on behalf of the burners, samples showing over 95 per cent. of total lime and over 93 per cent. of free lime being submitted with tenders by two local burners. Both of these were made from coastal limestone capstone (duricrust). A few years ago it was practically impossible to obtain lime assaying over 65 per cent. free CaO.

The present Government specification for builders' lime is:—

“A fair sample taken from the consignment shall show not more than the following ignition losses, according to place of sampling:

- (a) If sampled and sealed at the kiln, 10 per cent.
- (b) If sampled and sealed on delivery on the job or elsewhere within a radius of three miles of the Perth Town Hall, 15 per cent.

“The sample, wherever taken, shall after ignition contain not less than 80 per cent. of total calcium oxide.”

Ceramic Minerals.

Seventeen samples of clay were submitted to chemical, physical and burning tests. Mr. Bowley gives some details of four which are well suited for use in the manufacture of white ware and cream-coloured ware.

Sillimanite, one of the most valuable refractory minerals, has been known for some years in the Chittering Valley. This year, for the first time, several tons of hand-picked concentrates were mined and used in the manufacture of refractory bricks.

A thorough investigation was made by myself, both in the laboratory and in the pit, of the clays used in the manufacture of firebrick at Clackline. Contrary to previously held views it was found that the greater part of the clay consisted of a completely kaolinised mica-sillimanite schist of sedimentary origin. It still carries 5 per cent. or more of sillimanite, which should add greatly to the quality of the bricks made from it. The pit also contains kaolinised and bleached dyke rocks, the clays from which are mixed with the kaolinised schist.

Further large deposits of kyanite, another important refractory, have been found in the Chittering Valley, where in years to come there will doubtless be a large production of sillimanite and kyanite for use in the ceramic industry.

Assay Weights.

Owing to the poor standardisation of the small weights known as “riders” purchased for the State Batteries, all those purchased have been submitted to us for checking and standardisation. Errors of 3 per cent. on either side of the true weight are quite common, and with gold at £8 12s. an ounce are of grave importance. When the weights of the riders are below standard they are necessarily rejected. When they are above they are trimmed to reduce the error to not more than about 0.5 per cent., the final error being notified to the user so that he may allow for it in his assays.

Official Committees.

Throughout the year I attended at regular intervals meetings of the following committees:

- Food and Drug Advisory Committee.
- Metropolitan Water Supply and Sewerage Advisory Committee.
- Oils Committee of the Tender Board.
- State Committee of the Commonwealth Council Scientific and Industrial Research.

In October I was appointed by the Government a trustee of the Public Library, Museum and Art Gallery of Western Australia.

Publications.

The only publications by members of the staff during 1935 were:

- B. L. Southern (with L. J. H. Teakle of the Department of Agriculture)—An investigation of the terrace soils of the Gascoyne River at Carnarvon. *Jour. Dept. Agr. W.A.* 12, pp. 245-259.
- E. S. Simpson—Note on an australite observed to fall in W.A. *Jour. Roy. Soc. W.A.* 21, pp. 37, 38.
- E. S. Simpson—Mineral Resources of Western Australia (Fourth edition entirely rewritten). 24 page folder. Government Printer, Perth.

Sectional Reports.

Attached hereto will be found sectional reports by the Assistant Government Analyst and the other two Supervising Chemists. Their duties have been successfully carried out in the face of considerable difficulties due to much ill health and severely restricted expenditure on books of reference and equipment generally.

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

Perth, 28th February, 1936.

SECTION I.—FOODS, DRUGS AND TOXICOLOGY.

By H. E. HILL, A.I.C., A.A.C.I.

During the year 864 samples were examined, compared with 726 for 1934, an increase of 138. Mr. F. E. Chapman was absent on long service leave in England and on sick leave from April to the end of the year, and Mr. J. Pericles resigned in March, his position being filled by the appointment of Mr. H. Sedgman, B.Sc., A.A.C.I., in August.

A great variety of materials (109 different kinds) was examined, many in an investigatory and advisory connection. The work of the section would be greatly expedited if the full-time services of a laboratory assistant were available instead of, as at present, only on alternate days. Much time is spent by officers in assembling and dismantling apparatus and in various preparatory work that can be done by a trained laboratory assistant. The increasing volume of work and number of samples could thus be dealt

with more efficiently. The section is handicapped by the lack of certain modern equipment, which includes an ultra-violet lamp (for which constant use in a hundred and one ways arises), a modern all-round gas analysis apparatus, and spectroscopic equipment.

The more important classes of work dealt with were as follow:—

Foods.—Altogether 268 samples of foodstuffs were examined, derived mainly from two sources—the Department of Public Health and the Government Tender Board, in connection with the allocation of contracts and the testing of supplies. The former accounted for 139 samples, and the latter 129. The following table summarises some of the principal items:—

Food.	No. of Samples.	No. below Standard.	Remarks.
Milk	44	13	Adulteration with water and skimming.
Vinegar	29	15	Chiefly deficiency of malt and labelling.
Jam	29	14	Not recommended for use in Government institutions owing to generally low quality such as flavour and below 68 per cent. soluble solids.
Sauces, pickles and chutney	25	16	Foreign vegetable matter; colouring matter not declared, etc.
Jelly crystals ...	11	10	Low gelatine content, poor setting power and flavour.
Essences	18	8	Chiefly shortage of citral content and labelling.
Tripe	18	7	Treated with alkaline peroxide—high pH.
Butter	12	5	Excess water.
Margarine	5	2	Contained yellow colouring matter to resemble butter, contrary to the Dairy Industry Act.
Honey	6	...	All of good quality.
Sausages	7	5	Excessive starch or preservatives.
Summer drinks and soda water	8	5	Contained copper, lead or saccharin.
Self-raising flour	8	4	Deficient in carbon dioxide: one sample highly bleached.

Vinegars featured prominently again as in previous years, the tide of falsely described brands not yet having been stemmed. A number of vendors were prosecuted by the Department of Public Health, several brands of vinegar being concerned in court proceedings for the fifth and sixth time. In most cases the odium falls on the retailer, while the manufacturer usually pays the fine for him and is content to do so, escaping publicity and making far more in profits by the offence than the value of the fines. An undesirable feature is the frequency with which foodstuffs such as vinegar, pickles and sauces are put up by one or two local manufacturers in containers belonging to and embossed with the names of other makers (often of superior lines). This tends to be misleading and may convey an unwarranted impression of superior quality. Any design or lettering on a package constitutes a label within the meaning of the Food and Drug Regulations and therefore these embossed brands can be read as labels.

A sample of cider vinegar which was examined proved to be only a weak variety, and its label contained an entirely misleading statement about its digestive powers. A sample of imitation essence of rum for the preparation of flavouring used in "milk bars," which was submitted by the Chief Inspector of Licensed Premises, Police Department, was found to contain 84 per cent. of proof spirit and 6.3 per

cent. esters, mainly ethyl acetate. It was also flavoured and coloured with vanilla and caramel respectively. It is doubtful whether any ethyl butyrate or amyl acetate was present.

Samples of "protein bread" and "slimming bread" as sold to the public were analysed with ordinary brown and white bread for comparison. The following figures were obtained by Mr. F. J. Malloch:—

Type.	Ordinary.	Ordinary.	"Protein" Bread- Starch reduced.	"Protein" Bread- Starch reduced.	Patent A "Starch reduced."	Patent B "Slim- ming."
Colour	(White)	(Brown)	(White)	(Brown)	(White)	(Pale Yellow)
Weight of loaf (gms.)	485	410	477	469	450	149
Density (gms. per cub. in.)	5.8	6.8	5.0	6.2	4.6	1.9
<i>Analysis—</i>	%	%	%	%	%	%
Water	43.2	48.9	43.3	47.2	41.8	15.6
Total carbohydrates (incl. dextrin)	38.9	30.5	38.3	31.8	38.2	40.8
Protein (N x 5.7)	6.5	6.0	6.7	7.4	8.5	23.4
Undetermined	11.4	14.6	11.7	13.6	11.5	20.2
Total	100.0	100.0	100.0	100.0	100.0	100.0
<i>Calculated on a Water Free Basis—</i>						
Carbohydrate	68.5	59.7	67.6	60.2	65.6	48.3
Protein	11.4	11.8	11.7	14.1	14.5	27.7
Ratio; Protein : Carbohydrate ...	1 : 6.01	1 : 5.06	1 : 5.78	1 : 4.27	1 : 4.52	1 : 1.75

Leaving out of consideration for the moment the "slimming loaf," which has been made from flour considerably reduced in starch content, there is little difference between the others and ordinary white bread. Weight for weight they contain about as much carbohydrate, and although the ratio of protein to carbohydrate has been slightly reduced, the term "protein bread" seems hardly justified. The "slimming loaf" contains more carbohydrate than any of the others as it is much drier, but the protein content is much more than correspondingly increased. The density is very much lower (approximately one-third that of white bread) and for similarly sized slices the slimming loaf would provide a third of the carbohydrate, but an equal amount of protein, to that in a slice of white bread.

Other samples examined were baking powder, bacon, gelatine, cream of tartar, custard powder, desiccated coconut, tinned fruit and candied peel, dough (for bleaching agents and "improvers") and metal foil wrapping around cheese.

Drugs.—Fifty-four samples were examined during the year. This was an increase over the previous year, due mainly to the number of ether samples (42) tested for the Department of Public Health and hospitals for suitability for anaesthetic purposes. A large proportion failed to comply with the British Pharmacopoeia 1932 test for peroxides. The test is important because of the harmful after-effects which are attributed to using ether containing peroxides for the production of anaesthesia. A number of consignments failed even when newly opened, but development of peroxides is also prone to take place after opening and transferring to small bottles for distribution and use. Despite efforts by those concerned to prevent it, bottles may be left for varying periods partly full after being opened and partly used. Such ether may several times have been exposed to fresh air and light before being completely used, and is usually found to contain a considerable amount of peroxide.

Experiments were conducted to try to find a suitable inhibitor to prevent the formation of peroxide under these admittedly undesirable conditions. A

number of materials was tried, including copper gauze α naphthol, pyrogallol and dyestuffs. Brown bottles (1 lb.) partly filled with ether free from peroxide and containing the inhibitor were exposed to direct sunlight at a window during one month. They were periodically opened and tested. The control sample developed a large amount of peroxide. The dyestuffs which it is desired to use could not be obtained at the time, but Sudan I (0.05 per cent.) appeared to afford some protection. A concentration of 0.1 per cent. α naphthol gave fair protection. A thin roll of bright copper gauze, about 20-mesh, standing upright to the shoulder of the bottle completely prevented the formation of peroxide. Not a trace was developed. The copper became darkened and would require to be de-oxidised before using again. It has been found, however, that apparently copper gauze will not regenerate pure ether from ether already containing peroxide. The procedure of placing a roll of copper gauze in the opened ether bottles has been recommended to hospitals and is now under trial.

Other drugs examined were tincture of opium and an alleged epilepsy cure, which was found to consist of a solution of potassium bromide and sugar, coloured with caramel.

Toxicology and Police Cases.—One hundred and fifty exhibits and specimens were examined for poisons and other substances of pathological significance, compared with 120 for 1934. There were 137 exhibits in connection with 57 cases of human poisoning or supposed poisoning. Most of these were suicides, in connection with many of which evidence was given at inquests by myself or Mr. Malloch. These cases fall into the following groups:—Lysol or other phenolic disinfectant compound 7, strychnine 6, cyanide 5, arsenic 3, alcohol (including Chinese "whisky") 2, hydrochloric acid 2, ammonia, carbon monoxide, chloral, paraldehyde, hebaral sodium (sodium hexyl ethyl barbiturate), nitrobenzene, gelignite, abortifacient pills, A.B.C. liniment (aconite, belladonna and chloroform) one each, negative 23.

In the case of nitrobenzene poisoning the deceased appeared to have taken material which he had on his premises for manufacturing purposes. The initial stomach wash-out yielded 0.045 gm. of nitrobenzene, but none was obtained from the stomach or liver after death a day later. Indications of the presence of aniline, into which nitrobenzene is said to change in the body, were obtained, however.

In a case of acute alcoholic poisoning the liver contained 0.13 per cent. of ethyl alcohol, and the urine 0.20 gm.

A case of strychnine poisoning occurred during the year in which a child aged 17 months obtained access to and swallowed a number of a well-known proprietary line of chocolate-coated pills containing strychnine, aloin and phenolphthalein. These pills are properly labelled "poison" and are given to adults in doses of 1 to 3, but it should be recognised by the public that to young children much smaller doses of strychnine and most other poisons are dangerous than can safely be taken medicinally by adults. In this case three pills contained sufficient strychnine to kill a very young child.

In a second case a child obtained and sucked a small piece of potassium cyanide which had been thrown out. It should be unnecessary to say that poisons and medicines, especially when of attractive appearance to children, should be kept well out of their reach, and that unlabelled substances, of which the identity is not known, should be carefully destroyed by deep burial.

In a case of apparent poisoning by corrosive acid where, although everything pointed to hydrochloric acid, a definite opinion could not be given on the analysis of the stomach, it was found possible to show, by examining the blue serge suit which the deceased was wearing at the time of his death, that he had undoubtedly handled hydrochloric acid. An aqueous extract of stains on the serge a month later gave pH 2.8-3.0 and 0.51 grams of chloride calculated to hydrochloric acid, as against neutrality and pH 6.9-7.2 with nil to .002 per cent. chloride from other parts of the fabric, and new serge respectively. The titratable acidity was very low and not consistent with the chloride. A piece of serge after impregnating with strong hydrochloric acid and standing five days gave pH 2.0 with chloride 0.31 grams, and titratable acidity calculated as hydrochloric acid also low in comparison with chloride.

Specimens of axle-grease from a car, taken from a hub-cap found on the scene of an accident, and from a garage, were submitted by the Traffic Branch of the Police Department with a view to correlating the car with the accident. It was found possible to show that the first two were of similar age and consistency, and that all three greases were of the same manufacture. Evidence to this effect was given in court, where a conviction was recorded.

A sample of vegetable marrow submitted to the Department of Public Health by a private person was examined to see if its extremely bitter taste could be accounted for. It appeared quite normal to the eye and no extraneous substance was present. A small quantity of an extremely bitter substance was isolated, which appeared to be a glucoside, and gave a violet-red colour with concentrated sulphuric acid. This was apparently a product of the metabolism of this particular marrow. The Plant Pathologist (Mr.

H. A. Pitman) advises that melons having a similarly bitter taste are sometimes encountered. They are known as "rogues" or "freaks" and are apt to show up unless seed is carefully selected. A case is known within the experience of the writer where a whole batch of home-made chutney was spoilt by one of these melons. Such vegetables, therefore, should always be tasted before being used for preserving.

Twelve samples were examined in connection with the poisoning of animals. In one case a heifer was given nearly a pound of what was thought to be "Epsom salts" dissolved in water. The animal died in 20 minutes with pronounced spasms. The drug proved on examination to be commercial ammonium sulphate, largely used as a fertiliser. An experiment conducted by the Veterinary Pathologist, Dr. H. W. Bennetts, confirmed the toxicity of this substance for smaller mammals using approximately the same proportions to body weight.

Liquors.—Twenty-two (22) samples of liquor were examined during the year, consisting of beers (4), hop beers (3), in connection with proceedings under the Licensing Act, brandy (2), gin (2), whisky (5), rum (1), and wine (4). Three samples of wine contained saccharin (up to 8 grains in a gallon). A sample of gin was falsely labelled and one brandy and two whiskies were below the legal standard.

In a case which was initiated by the Liquors Inspection Branch of the Police Department a publican was charged under the Health Act with selling beer not of the nature, substance and quality of the article demanded. A comparison with a sample taken from reserve at the brewery originally from the same brew and tank showed that it had 6.2 degrees less original gravity, more extract, ash and considerable acidity, as well as sediment, including ants. It was contended that "slop" or waste beer had been mixed with the sample. The case was dismissed by the magistrate, mainly on the grounds that the sample had not been properly divided by the Inspector because the report of the analyst for the prosecution (H.E.H.) mentioned sediment, the third reserved sample showed sediment, but the analyst for the defence said he found no sediment.

Experiments which were made to determine the loss of spirit strength of whisky exposed in bottles provided with an automatic metal measure showed that a regular loss of about one degree in a month took place at room temperature 60-70 degrees F. The measure had a small air-release hole 3 mm. in diameter and a lightly covered spout.

Only one Sikes hydrometer was tested during the year. There does not appear to be much care taken by persons in the liquor trade to ensure that their instruments are in good order by having them tested at regular intervals.

Government Supplies Other than Foodstuffs.—Forty-five (45) cleaning and laundry materials were examined for the Government Tender Board in connection with the letting of contracts for supplies. These included soaps and cleaning preparations (24), starch (12), polishes (6), candles and blacklead. Other materials tested against specifications were lubricating oils (15), petrol (5), insecticides (17), lysols and phenyles (8), galvanised wire and wire netting (5).

Miscellaneous Samples.—These included—

Human Milks.—Fifty samples were analysed for infant welfare clinics, and the King Edward Maternity Hospital, in connection with infant nutrition.

Tan Barks.—Eighty-three samples of barks of various species of eucalypt, mainly mallet, were analysed for tannin content. Most of these were for the Forestry Department.

Various.—These included gas (12), cattle dip (20), explosives and fireworks (15), bitumen-oil mixtures for the Main Roads Board, as well as supposed oil residuum, sand, drift resin, ferrosilicon and other materials picked up in various localities and sent to the Department for identification.

Sanitation of Factories.—The work which was commenced by Mr. J. C. Hood in 1934, following his appointment as an inspector under the Factories Act, was continued. Twelve inspections in collaboration with the Chief Inspector of Factories were made of premises in which hazardous occupations were being carried on. These included plumbing, tin-smithing and canister-making workshops, printing (linotype) establishments and lead accumulator and battery workshops.

Sixteen samples of air were examined, mainly for carbon monoxide in dangerous amounts, as an indication of poor and inefficient ventilation and insufficient removal of products of combustion from blow-lamps, solder baths, etc. In no case did the amount of carbon monoxide exceed the safe limiting figure usually accepted for workers exposed for several hours, viz.:—0.010 per cent.

Several determinations were made of lead in the air being breathed by workers in workshops where a lead hazard might be supposed to exist, especially lead accumulator repair shops. The method adopted was that of drawing air from a selected point through a layer of cotton wool at the approximate rate of respiration for a number of hours, usually 4½. The particulate lead retained on the wool was determined. On a basis of 32 per cent. as the average retention of lead by the lungs, which has been found by other workers for conditions of gentle exercise, the amount of lead which would be inhaled and retained by a worker during a working day (eight hours) was calculated. A limit of two milligrams a day has been put forward by Sir Thomas Legge, late Senior Medical Inspector of Factories in England, as the lowest daily dose of lead which, inhaled as fume or dust, may in course of years set up chronic plumbism. The atmospheric lead met with in industry is particulate.

The quantities of lead found in four samples taken in workshops and calculated on this basis were as follows:—

Accumulator workshop ("pasting" plates)	0.8 milligram.
Battery workshop (casting plates)	0.5 "
Printing shop (linotype room)	0.2 "
Canister workshop (gas-heated solder channel)	0.2 "

Mr. Hood was able to make a number of useful suggestions to the Chief Inspector of Factories regarding the installation and management of cowls

and vents over charcoal braziers and gas-heated pots used for melting solder and type-metal, and for improving ventilation and fume removal generally.

Miscellaneous Investigations, Advice, Etc.—A considerable amount of time was spent during the year in various minor investigations which had to be carried out in order that Government Departments might be advised on problems of varying importance. One officer has had to follow up the question of corrosion in water supply and sewerage systems, with a view to prevention by suitable treatment and protective coatings. Some attention was given to mixtures for impregnating pipe wrapping. In addition some analyses were made of sewer gas and sewage effluent, with a view to determining the efficiency of cascading as a means of removing hydrogen sulphide gas which on liberation and oxidation causes intensive corrosion of cement.

Exhaust gases from Diesel-engined locomotives were analysed for carbon monoxide to determine the amounts of that poisonous gas given off by such engines, which were proposed to be used below the surface in mines.

A large amount of information and advice in other connections has been given to Government Departments and members of the public.

SECTION II.—MINERALOGY, MINERAL TECHNOLOGY AND GEO-CHEMISTRY.

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

Four thousand four hundred and sixty-five samples were entered for examination during the year. This exceeded the figures for the previous year by 1,185. Gold assays accounted for 1,182 of this increase.

It has only been possible to deal with the large number of routine samples now coming forward by sacrificing a number of pressing and important investigations. Practically the whole of the staff was engaged, during the latter months of the year, on gold assaying. This state of affairs should not be allowed to continue as it is essential that facilities should be available for carrying out more investigatory work if this office is to satisfactorily carry out its functions and to be of the greatest benefit to the mineral industry.

The installation of an up-to-date assaying plant to replace the antiquated and worn-out equipment now available would enable me to deal more expeditiously with the gold and silver assaying. Although at times all the members of the professional staff were concentrated on assaying, it was impossible to avoid appreciable delays in issuing the results. This caused some inconvenience and dissatisfaction to our clients, with a consequent loss of revenue to the Department.

On account of the renewed interest in the State's mineral resources and the development of local industries, and because of the increased activities of the Geological Survey Branch, extra demands are now being made for more extensive chemical and mineralogical investigations, for which the staff of the section are particularly fitted. This demand can only be met either by supplying more up-to-date equipment or increasing the professional staff of this section.

Gold Assays.—Altogether 4,034 samples were received for gold assay during the year, compared with 2,852 for the previous year.

The samples were classified as follow:—

Year.	1935	1934
Public Pay	2,078	1,484
Public Free	537	504
Official	1,419	864

The revenue received from this source totalled £1,311 11s.

Included in the samples classified as Public Pay were bore cores from the following mines:—Aladdin Gold Mine, Nannine; Atlas Gold Mine, Retaliation; Apex Gold Mine, Marble Bar; Beryl Gold Mines, Kundip; Day Dawn Gold Mine, Day Dawn; Emu Gold Mines, Lawlers; Gladiator Gold Mine, Laverton; Jupiter Gold Mine, Southern Cross; Leonora Gold Mine, Leonora; Lochinvar Gold Mine, Paddington; Mars Gold Mine, Gabanintha; Nannine Gold Mine, Nannine; North Kalgurli Gold Mine, Kalgoorlie; Phoenix Gold Mines, Coolgardie; Riverina Gold Mine, Mulline; Royal Standard Gold Mine, Yuin; Sand Queen-Gladsome Gold Mines, Comet Vale; Southern Cross United Gold Mines, Southern Cross; Wheel of Fortune Gold Mine, Lennonville; Woolgar Gold Mine, Menzies; Yellowdine Gold Mine, Yellowdine; Youanmi Gold Mine, Youanmi.

Included in the official samples submitted for gold assay were 1,134 tailings samples from the State Batteries. Of these, 134 were for umpire assay, the balance being plant check samples. The State Mining Engineer forwarded 167 samples from the 250ft. level of the Big Bell G.M. at Coodardy. These samples were taken to check the mine assay figures submitted in connection with their application to the Government to build a railway to their leases. The ore from this level consisted mainly of a pyritic mica schist, associated with quartz, quartzite and pegmatite, and containing small amounts of arsenic, antimony, copper, lead, molybdenum and zinc. Tourmaline is a fairly common constituent of the ore.

Assay Weights (Riders).—During the year we have had occasion to check a number of batches of centigrain and milligram riders obtained by the State Batteries Branch from local warehouses. On comparing them with National Physical Laboratory Standards it was found, in a number of instances, that they varied considerably in weight, the error in some cases rising to 5 per cent. of the reputed weight. Only in rare instances were they accurate to within ± 1 per cent. A batch of 24 centigrain riders examined recently weighed—

Three, 0.0102 grain, nine, 0.0103 grain, ten, 0.0104 grain, two, 0.0105 grain.

The amount to which these variations would affect the accuracy of a gold assay may be gauged from the following:—

An error of 0.0001 grain of gold from a charge of one grain assay ton (326.66 grains) of ore represents 4.8 grains per long ton, equal to 21 pence at the present Australian price of gold.

Until more reliable and accurate riders are available it would, therefore, be advisable to have all riders checked against National Physical Laboratory Standard riders on a balance with the required sensitivity.

The standard riders at present available in this laboratory have been standardised at the National Physical Laboratory, England, on the basis of weighings made in air against standards of known mass and of specific gravity 8.4 without applying any buoyancy correction. The certificates accompanying the riders give the mass of the weight to an accuracy of ± 0.0001 grain for centigrain riders and ± 0.00001 grammes for milligram riders.

Lime.—The specification for "builders' lime" for Government supplies provides that the lime, when sampled at the kiln, shall show not more than 10 per cent. ignition loss, and shall after ignition contain at least 80 per cent. of total calcium oxide. That it is possible to produce, in the metropolitan area, a burnt lime (quicklime) to comply with the above standard, has been indicated by the analyses of samples submitted during the year by the tenderers for Government supplies.

Samples received in airtight containers from two different local manufacturers were of excellent quality for both metallurgical and builders' purposes. The figures obtained on these samples were:—

	(a)	(b)
	%	%
Free lime, CaO	93.49	93.55
Total lime, CaO	95.43	95.99
Ignition loss	2.91	1.95
Total lime, CaO (after ignition, caled) ..	98.29	97.89

Quicklime is a perishable product. It readily hydrates, or air slakes, when exposed to air of average humidity, especially under conditions of the higher temperature of the summer. The following figures for ignition loss on samples taken at the place of delivery show the extent to which hydration of high grade metropolitan burnt lime proceeds during transport to various inland localities.

State Battery.	Distance from Perth to nearest Railway Station—miles.	Ignition loss %
Boogardie ..	482	4.83
Kalgoorlie ..	375	8.19
Meekatharra ..	600	3.20
Ora Banda ..	398	6.30

The poor grade of mortar to be seen in some of the older buildings in the city is no doubt due to some extent to the use of low grade quicklime. The hardening of a lime mortar is due to the conversion of the quicklime added into calcium carbonate by absorption of carbon dioxide from the atmosphere. A dense hard and impervious mortar is only obtained when sufficient high grade quicklime has been added to fill all the voids in the clean sand used.

The examination, during the year, of 49 samples of burnt lime from various sources has shown that a high grade lime suitable for all building and metallurgical purposes is now obtainable from local lime-burners.

Tantalite.—Eighteen samples of tantalum-bearing ores were examined during the year under review. Seventeen of these were from the Pilbara District, the majority of which represented parcels of ore of about 1,000 lbs. weight each for disposal to either American or Japanese buyers.

The alluvial tantalite produced for sale from Tabba Tabba has invariably shown a low niobium content, the average figures for several parcels being— Ta_2O_5 69.2 per cent., Nb_2O_5 2.9 per cent., SnO_2 9.9 per cent.

Manganocolumbite, with a specific gravity of 6.0 and containing approximately 34.5 per cent. of tantalite oxide, was received from 20 miles S.E. of the tantalite lease at Tabba.

A specimen of black mineral from the felspar vein on M.L. 72, at Londonderry, proved to be manganotantalite carrying about 74 per cent. of tantalite oxide.

Quartz Sand.—A very fine quartz sand which, on account of its fineness and angularity of grain, is well suited for use in the manufacture of abrasive soaps and cleansers, was received from 5 miles west of the Midland Railway, 147 miles from Perth. It contained 95.3 per cent. of silica.

A sizing test gave the following figures:—Pass 200 mesh, 97.85 per cent.; Refuse 200 mesh, pass 90 mesh, 1.95 per cent.; Refuse 90 mesh, pass 60 mesh, .07 per cent.; Refuse 60 mesh, pass 30 mesh, .10 per cent.; Refuse 30 mesh, .03 per cent.

Sillimanite.—A highly weathered quartz mica sillimanite schist, which may have a special value in the manufacture of refractories, has been proved to occur in large quantities in the clay pit on Loc. 171, Claekline.

A specimen of mica schist containing white sillimanite was received from Denmark.

Coal.—Two samples of coal from No. 5 Section, No. 1 Heading at the west end of the south fault in the Co-operative Mine, Collic, gave the following figures on analysis:—

	Top coal. 4ft.	Bottom coal. 3ft.
<i>Proximate analysis on air dried coal (24 hours)</i> —		
	%	%
Moisture	17.12	16.57
Volatile hydrocarbon	26.78	28.03
Fixed carbon	50.63	49.35
Ash	5.47	6.05
	100.00	100.00

Ratio of fixed carbon to volatile hydrocarbon 1.89 : 1 1.76 : 1

Calorific value (by bomb calorimeter)—

On air drying for 24 hours:		
B.T.U.	10,312	10,258
On ash and moisture free coal:		
B.T.U.	13,321	13,256

In ash—

Ferric oxide, Fe_2O_3	11.72%	14.80%
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Antimony.—A sample of picked ore for shipment from the Blue Spec G.M. at Middle Creek, consisting of finely granular stibnite with a little antimony ochre and quartz, assayed:—Antimony, 52.02 per cent.; Sulphur, 16.15 per cent.; Silica, 27.52 per cent.; Gold, 13 ozs. 12 dwts. 12 grs. per ton; Silver, 4 dwts. 12 grs. per ton.

Clays.—Seventeen samples of clay were examined along the usual lines during the year. Two of these were useful types for the manufacture of white ware, whilst others were suitable for sanitary and cream-coloured ware.

The following are of special interest:—

Colour.	Clay substance + grit under 90 mesh.	Ashley plasticity figure.	Colour on burning at 1,150° C.	Incipient vitrification.
1. Cream	96.81	46	Pure White	+1,350° C.
2. White	99.83	28	Good White	1,350° C.
3. White	89.75	6	Creamy White	1,150° C.
4. Creamy White	92.26	62	Creamy White	1,250° C.

Locality—1, Westonia; 2, Jimperding; 3, Glen Forrest; 4, Gosnells.

A soft buff-coloured clay of a basic type from Woodlupine Brook, Kalamunda, had the following chemical composition:— SiO_2 , 39.57%; Al_2O_3 , 39.60%; Fe_2O_3 , 4.63%; TiO_2 , 1.27%.

Miscellaneous Mineral Notes.

Molybdenite (molybdenum sulphide) was recognised in the gold ore from the 250ft. level, Big Bell G.M. at Coodardy.

Tourmaline (boro-silicate of iron, magnesium, etc.), is a common constituent of the auriferous mica schist at the 250ft. level, Big Bell G.M., Coodardy.

Vanadinite (lead chloro-vanadate) associated with anglesite and cerussite was detected in a quartzose gold ore from P.A. 4281 at Ennuin.

Almandine (silicate of iron and aluminium).—A light red-coloured sand from the beach at Geraldton was found to contain approximately 50 per cent. of almandine garnet and 25 per cent. of shell fragments, the remainder consisting of ilmenite, zircon, rutile quartz and limonite. Almost the whole of the sand was fine enough to pass a 60-mesh screen.

Bismutite (hydrous bismuth carbonate), *bismutospherite* (bismuth carbonate) and *agricolite* (bismuth silicate) were present in an auriferous quartz ore from Garrett, about nine miles from Yellowdine.

Hydromagnesite (basic magnesium carbonate) in a micro-crystalline form, associated with some magnesite, calcite and kaolin, in the form of a white powder, was received from Welbungin.

Apatite (fluo-phosphate of lime).—Phosphatic nodules, consisting principally of apatite, with which is associated some clay limonite and calcite and crystals of barite, were received from Dandaragan. A sample of the material, brought up from a depth of 336 feet in No. 1 Bore near Billiecuttharra Well, north of Gantheaume Bay, was also found to consist of coprolite nodules. These are composed of apatite, glauconite and calcite, with some organic matter, pyrite and rounded grains of quartz and felspar. A distinctly fetid odour, approaching that of a mixture of hydrogen sulphide and phosphide, was detected when crushing the nodules.

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

- (a) *Minerals.*—Calcite, Lemmonville; Cerussite, Northampton; Chlorite, Kalgoorlie, Mt. Satirist; Diopside, Davyhurst; Epidote, Windamurra; Hydrohaematite, Inglehope; Hypersthene, South Kuminin; Lithiophilite, Wodgina; Muscovite, Wodgina.
- (b) *Rocks.*—Basic gneiss, Edwards Find, Jilbadji; Diorite, Burracoppin; Hypersthene diorite, Burracoppin; Fayalite gabbro, Burracoppin; Granite, Mundaring; Garnet hornstone, Toodyay.

SECTION III.—AGRICULTURE, WATER SUPPLY AND SEWERAGE.

By A. J. HOARE, A.A.C.I.

The total number of samples entered for analysis during the year was 1831, an increase of 259 over that received for the year 1934. The sources of the samples will be found on page 93.

Staff.—Mr. J. C. Cavanagh, B.Sc., who filled one of the temporary positions in the section, resigned in June, and Mr. S. T. Evans, B.Sc., was appointed to fill the vacancy in August. There was a shortage of staff during the latter part of the year, due to an officer being on long service leave, and another loaned to one of the other sections for about five weeks.

Soils.—The total number of soils entered for examination during the year was 730; of these 614 were submitted by the Department of Agriculture. The majority of the soil samples (567) submitted by this Department came from the Salmon Gums area, being type profile samples for general analysis. The balance included 17 samples from five different swamps in and around the metropolitan area, collected by the Plant Nutrition Officer and Mr. Southern of this section; these were submitted to a general chemical and mechanical examination, and the information obtained will be of great value to the officers concerned in the Department of Agriculture.

In addition there were 24 from the Mulga Zone, also sent in by the Plant Nutrition Officer, for mechanical analysis, replaceable bases, reaction and description of the stones.

The Forests Department submitted 97 soils, 60 of which were for nitrate determination and were collected at the pine plantation at Applecross, whilst 29 soils collected from good and poor jarrah country were submitted to a general mechanical and chemical examination. The balance of the samples (eight) came from Boranup, chemical analysis only being required.

Soils sent in privately totalled 15, the usual query being "why do plants die in this soil." The usual trouble is excessive water, soluble salts or acidity.

Fertilisers.—The number of fertilisers received during the year was 29. Of these 14 were official samples submitted by the Inspector of Fertilisers, nine of which complied with the regulations in all respects, the balance differing in one or more of the items. Samples of superphosphate from each of the State Experimental Farms, seven in all, were also received for check analysis against the guarantee, as supplied by the manufacturers. Two samples of sheep manure, from the North-West, sent in by the Tropical Adviser, were also examined. Four samples

of rabbit droppings from Meekering were submitted by the Agricultural Department for analysis, with a view to gaining some information as to why sheep have a liking for same.

Fungicides and Insecticides.—Of the 10 samples received, nine were for analysis under the Plant Diseases Act. Under this Act a certificate of analysis is required from this Department before the material can be registered at the Agricultural Department and placed on the market for sale in the State. The odd sample consisted of sodium chlorate, used as a weed killer.

Fodders and Poultry Meals.—Sixteen samples in all came under this heading, 12 of which were meat meals. Of the meat meals, seven represented different brands on the local market; the protein and ash content of these varied considerably, viz. protein 35.44 per cent. to 68.34 per cent; ash 10.04 per cent. to 42.38 per cent. One sample of salt bush and one of "shepherd's lucerne" (*Lepidium hyssopisolum*) from the Salmon Gums area were also sent in for analysis to determine their feeding value for stock.

Waters.—The number of waters received during the year was 623, a slight increase over that of the previous year. The Metropolitan Water Supply Department accounted for 188; these were taken principally from the different sources of supplies (reservoirs, streams, and deep bores) to the metropolitan area. These waters are all of good potable quality. Twenty-five samples of ocean water, sent in by the above Department, will be dealt with under sewage. The Department of Works and Labour submitted 119 samples in all; these comprised country town supplies, also regular samples taken from the Mundaring reservoir and Kalgoorlie reticulation. In the majority of cases, they were of good potable quality. Waters sent in by farmers, stock owners, and market gardeners totalled 239, and, as is always the case, a fair proportion of them were too saline to be used for the purpose for which they were required. The question of water supplies for boilers and the cooling of Diesel engines is still a serious one for companies engaged in gold mining in this State. This year 34 samples were received in this connection, all of them being much more saline and corrosive than the waters generally found in other countries and used for similar purposes. These waters will all require treatment of some sort, either softening by one of the known processes, or zinc blocks suspended in the boilers, and a more frequent blowing off of the concentrated solution and accumulated deposits. The balance of the samples were odd ones sent in by other Government Departments.

Sewage.—Samples totalling 69, collected from the treatment works at Perth, Subiaco, Fremantle and Swanbourne, also from two of the public institutions and the Midland Junction Abattoirs, were received for analysis. The figures obtained indicated that considerable improvement could be made at some of the installations. The Metropolitan Water Supply and Sewerage Department submitted 25 samples of ocean water and one of effluent, taken at the ocean outfall north of the Cottesloe beaches; these were examined with a view to finding the rate of purification of a sewage effluent when it is allowed to run into the ocean.

Ash of Pines.—Altogether 23 specimens of pine needles, 16 of wood and 16 of bark, were examined during the year. The majority of the pines (16)

were taken from the Pardelup nursery, and comprised specimens of good and poor growth. Owing to the small size of the pines, the whole tree was sent in; the needles and bark were stripped off, and the wood cut into small pieces and allowed to dry in the air until required for analysis. An analysis was made of the ash, the needles, bark and wood being treated as separate samples; this work has now been finalised, but up to date no definite conclusions have been arrived at by the officers concerned in the Forests Department.

Barley.—Ten samples of locally grown barley were received from the Agricultural Department; the analysis, principally nitrogen content, was required to fix their value for malting purposes.

Zante Currants.—Early in the year, 36 samples of currants, grown under different fertiliser treatments, were sent in by the Fruit Branch of the Department of Agriculture, for the estimation of sugar. This calculated as invert sugar, and returned on a dry basis, ranged from 74.2 per cent. to 93.8 per cent. The water in the original fruit ranged from 72.9 per cent. to 80.6 per cent.

Pyrethrum Flowers.—Two samples of locally grown Pyrethrum flowers (*Chrysanthemum cinerariæ-folium*) were examined for the Government Entomologist. The plants were grown on rocky ground; the unopened and opened flowers were submitted, and the Pyrethrin I. content was found to be 0.373 per cent. and 0.462 per cent. respectively. These are above the medium toxicity class (0.26 per cent.-0.36 per cent.) as fixed in a classification of pyrethrums made at the Rothamstead Agricultural Experimental Station, England.

Miscellaneous Investigations.—Several odd samples, such as bones from a sheep; blood serum; rumen contents of a sheep; two stock licks; residue from the firebox of a boiler; cement from a cement-lined water pipe, before and after the passage of water; deposits from a sewer; liquid from a silo; and a deposit from a water filter, were submitted by various Government Departments for examination and report.

Brans and Pollards.—Fifty samples were entered for analysis. Forty-four of these comprised brans and pollards obtained from the milling of wheat samples, using the experimental mill; these were examined for moisture and protein. Only three samples of bran and three of pollard were submitted by the Inspector under the Feeding Stuffs Act, all of which, in some respects, failed to comply with the standards set down under the Act for moisture, crude fibre, and ash; although in some cases they came within the limits of variation allowed.

Flour.—During the year 90 samples were analysed, 79 of these being for the Department of Agriculture. They comprised 31 obtained from the milling of wheats grown at the State farms at Merredin and Wongan Hills; 32 samples of break and reduction flour from two flour mills, one using the long system of reduction, and the other the short system; 12 flours, break and reduction, collected during the milling of a soft wheat, using the experimental mill; and four flours milled from local and Eastern States f.a.q. wheats. The balance of the samples were six for export to China; one from a local mill, and four from the Tender Board.

Wheat.—Only 91 wheats were received this year, against 128 for the previous year. Of the number received, 31 comprised samples taken from plots grown at the experimental farms situated at Merredin and Wongan Hills; four local and Eastern States f.a.q. wheats for the season 1934-35; and one from a flour milling company. These were all milled, and as stated above, a general analysis made of the flour. The wheat itself was also ground in a Wiley mill, and the moisture, protein, and Pelschenke value determined.

Fifty-five samples received in connection with the Royal Agricultural Society wheatgrowing competitions, were also ground in the Wiley mill, and treated as above.

The figures obtained for the f.a.q. wheats are as follow:—

Lab. Nos.	1129	1474	1475	1476
Mark and Origin	Western Australia.	New South Wales.	Victoria.	South Australia.
Condition	Sound	Sound	Partly broken.	Sound.
<i>Grain Analysis:</i>				
Moisture, actual (per cent.)	9.84	10.62	10.83	10.47
Bushel Weight—Found (lbs.)	63½	62½	60½	61¾
" " Declared (lbs.)	62½	61¼	60	60½
" " Cleaned (lbs.)	64	63	61½	62½
Weight of 1,000 grains (grams)	38.77	41.95	37.59	38.61
<i>Milling Analysis:</i>				
Flour (per cent.)	70.9	71.3	71.0	71.1
Bran (per cent.)	18.1	17.3	19.8	18.7
Pollard (per cent.)	11.0	11.4	9.2	10.2
<i>Wheat Meal Analysis:</i>				
Protein (N x 5.83) (per cent.)	10.06	11.10	11.43	10.92
Pelschenke Test—Time factor (minutes)*	31	35	28	31
" " Specific protein quality	3.2	3.2	2.5	2.9
Ash (per cent.)	1.32	1.49	1.61	1.48
<i>Flour Analysis:</i>				
Lab. Nos.	1839	1840	1841	1842
Moisture, actual (per cent.)	11.24	11.50	11.68	11.75
Protein (N x 5.7) (per cent.)	9.21	9.70	9.60	9.60
Ash (per cent.) ... ..	.68	.68	.63	.66
Gluten, wet (per cent.)	28.90	30.07	29.22	28.44
" dry (per cent.)	9.08	9.67	9.41	9.53
Strength (water absorption) (per cent.)	52.9	53.7	53.3	53.4
Maltose figure, Kent Jones (per cent.)	1.89	1.85	1.68	1.72
Buffer. value, Pelschenke	1.30	1.20	1.30	1.30
<i>Flour Colour:</i>				
Pekar A	5	5	5	5
" B	4	4	4	4
" C	4	4	4	4
Petrol figure, Kent Jones	9.1	9.1	8.4	8.8

* On meal ground in standard Wiley Mill.

The wheat meal analysis is reported on a 10 per cent. moisture basis, and the flour analysis at a standard moisture of 12 per cent.

DIVISION VIII.

Report of the Chief Inspector of Explosives for the Year 1935.

The Under Secretary for Mines.

I have the honour to submit, for the information of the Honourable 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 1935.

The importation of explosives during the year shows an increase over that of the previous year. Table No. I gives the kinds and quantities of explosives imported into the State during the year.

These explosives arrived in eleven shipments, and on being submitted to tests for stability and sensitiveness, were found to comply with the requirements of the Act and Regulations.

TABLE No. I.

Importations of Explosives into Western Australia during 1935.

Explosives	Quantity in lbs.
Gelignite	1,519,050
Gelatine Dynamite	1,543,750
Blasting Gelatine	175,050
Permitted Explosives	111,800
Powder, Blasting and Pellet	110,000
Total	3,459,650
Detonators	No. 4,316,000
Fuse	Yards 4,704,000

A comparison of the quantities of explosives imported during the past five years is given in Table No. 2.

TABLE No. II.

Comparison of Explosives imported into Western Australia during the past Five Years.

Explosive.	1931.	1932.	1933.	1934.	1935.
	lbs.	lbs.	lbs.	lbs.	lbs.
Gelignite	565,500	1,067,250	1,125,700	1,411,900	1,519,050
Gelatine Dynamite	575,250	617,200	797,950	1,432,650	1,543,750
Blasting Gelatine	145,150	336,600	314,350	143,700	175,050
Permitted Explosives	20,000	38,050	149,750	75,350	111,800
Powder, Blasting and Pellet	90,725	136,875	127,500	146,250	110,000
Totals	1,396,625	2,194,975	2,415,250	3,209,850	3,459,650
Detonators, No.	1,805,000	2,370,000	3,310,000	2,644,000	4,316,000
Fuse, Yards	1,987,200	2,880,000	3,770,400	4,322,000	4,704,000

From the above figures it will be noted that there has been a steady and consistent increase in the quantity of explosives imported during the period, and the indications are that gold mining is developing in a way that the consumption of explo-

sives during the next few years will be greater than it has been in the past.

In Table No. III. figures showing the distribution of explosives in the different classes of industry in which they are used are given.

TABLE No. III.

Distribution and Consumption of Explosives for years 1934 and 1935.

Industry.	1934.		1935.	
	Lbs. used.	Percentages of total.	Lbs. used.	Percentages of total.
Gold Mining	2,503,500	91.1	2,922,850	91.2
Agricultural and Land Clearing	23,550	0.9	28,950	1.0
Government Departments, including Railways, Public Works, and Water Supplies	105,200	3.9	93,950	3.0
Quarrying	78,950	2.9	96,900	3.1
Coal Mining	37,950	1.2	50,040	1.5

Unfortunately there was a continued occurrence of accidents during the year in connection with the use of explosives in mines, in which lives were lost and men seriously injured. These regrettable accidents caused such uneasiness in the minds of all those interested in the mining industry that in August a conference was held in Kalgoorlie, at which representatives of the Chamber of Mines and the Miners' Union met Officers of the Department and discussed the question of measures that might be taken to reduce and, if possible, eliminate accidents connected with the use of explosives.

A proposal to use a cartridge igniter for fuses appeared to offer a definite margin of safety in connection with the lighting of a round of charges. This method was thoroughly investigated and arrangements were made with Messrs. Nobel (Australasia) Proprietary, Ltd., to manufacture cartridges for this purpose.

It is considered that the use of these cartridges eliminates risks connected with the lighting of a number of fuses, especially in shafts and winzes, to such an extent that there is ample justification for making their use compulsory.

The numbers of licenses issued for the storage and sale of explosives are given in Table No. IV.

TABLE No. IV.
Licenses issued during 1935.

Magazines on Government Reserves	...	44
Magazines used by Government Departments	...	29
Magazines on Private Property	... ..	48
Store Licenses—		
Mode (a)	... ..	106
Mode (b)	... ..	—
Fireworks only	... ..	259
Importation Licenses	... ..	2

Inspections of nearly all licensed magazines and premises throughout the State were made. As a result of these inspections there were no breaches of the Act discovered that warranted proceedings being taken, but a number of warnings were given to licensees in connection with minor irregularities with a view to procuring greater safeguards.

It was found necessary to destroy the following explosives as their physico-chemical condition was such as to render them unsafe to use and dangerous to store.

TABLE V.
Destruction of Explosives during 1935.

Date.	Place.	Kind and Quantity.	Remarks.
30-4-35	Fremantle	150 lbs. Nitro Compounds	Chemical deterioration.
30-5-35	do.	1,500 Detonators	Owing to deterioration.
1-7-35	Carnarvon	5 lbs. Gelnite	Chemical deterioration.
3-7-35	Roebourne	25 lbs. "	do. do.
10-7-35	Wyndham	2 lbs. "	do. do.
22-9-35	Southern Cross	20 lbs. "	do. do.
	do.	5 lbs. Gelatine Dynamite	do. do.
3-10-35	Kalgoorlie	25 lbs. Gelnite	do. do.
3-11-35	Reidy	5 lbs. Gelatine Dynamite	do. do.
16-11-35	Pithara	20 lbs. Gelnite	do. do.

The following tests were carried out with a view to determining the chemical purity and stability of the explosives imported, stored, and used in this State:—

TABLE No. VI.
Tests and Analyses made during 1935.

Heat Tests	... ..	1,482
Fuse Tests	... ..	432
Complete Analyses	... ..	19
Fireworks Tests	... ..	50
Velocity of Detonation	... ..	102
A.D.C. Tests	... ..	6
Tests of Detonators	... ..	55
Miscellaneous	... ..	47

A satisfactory feature of these tests is that the explosives being imported into this State are of a high standard of chemical purity, which makes for

stability in storage. Reasonably high velocities of detonation were obtained with every consignment of explosives, which assures satisfactory detonation of the charge, and where the explosive is used within a reasonable time of its arrival in the State, the products of combustion should contain a minimum of harmful gases, carbon monoxide, and the oxides of nitrogen.

There were four explosives added to the List of Authorised Explosives to be imported into, manufactured or stored in this State.

T. N. KIRTON,
Chief Inspector of Explosives.

11th February, 1936.