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SUMMARY REPORT ON THE ORE PROSPECTS OF SOME WESTERN
AUSTRALIAN GOLD MINES.

by

C.J. SULLIVAN.

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SUMMARY REPORT ON THE ORE PROSPECTS OF SOME WESTERN
AUSTRALIAN GOLD MINES.

A. - KAIGORLIE MINES:

By C. J. Sullivan. 1948/16

Kalgoorlie mines may be divided into three main classes:-

- (1) Those mines which, with the present price of gold appear to have a limited life which may lie in the range of 5 to 12 years. These mines comprise Goldmines of Kalgoorlie; Boulder Perseverance; Broken Hill Pty. Mine; The Parings Mine; and South Kalgurli Consolidated.
- (2) Mines on which there is no immediate prospect that production will cease owing to lack of ore, but which nevertheless could have a limited life under certain conditions - for example if a drop in grade with increasing depth became marked. These mines comprise Great Boulder Pty. Mine and the Kalgoorlie Enterprise Mine.
- (3) Mines to which it is at present impracticable to ascribe any limit of life. These mines are the Lake View & Star Coy. and North Kalgurli (1912) Ltd.

The mines whose life at present appear to lie within the range 5 to 12 years produce approximately 127,000 ounces annually. The intermediate group (Great Boulder Pty. Ltd., etc.) produces 110,000 ounces per annum, and the third group, whose future as far as ore reservations are concerned appears to be assured, produces some 215,000 ounces annually.

Consideration is being given to the opening of the Mount Charlotte Mine which on the estimated rate of production would produce about 80,000 ounces of gold per year. This production would make up for about two thirds of the loss in production which would be sustained if the mines in group (1) were closed down. However, under present circumstances and without a subsidy Mount Charlotte would be a very marginal operation.

- (1) (1) GOLDMINES OF KAIGORLIE: The leases held by this Company are shown on plate 1 accompanying this report. The salient features of production and the results of development are shown on Table 1.

Past Production:

	<u>Ore</u> <u>Tons of-</u>	<u>Gold</u> <u>Fine Ounces</u>
From 1937 to December, 1947	1,307,008	369,496

The present annual rate of production is 150,000 tons of ore containing approximately 37,500 fine ounces of gold.

Present Ore Reserves: The ore reserves at 18.3.1947 were 547,978 tons, averaging 5.2 dwt. per ton, or approximately 3.5 years ore supply.

The reserve consists of proved and broken ore and the tonnage of probable ore in known lodes is small.

Of the above reserves some 203,000 tons are contained in an open cut which is being mined at the rate of about 50,000 tons per year, giving the open cut ore a life of approximately 4 years. The cost of mining this ore is 8/- per ton as compared with the cost of mining sulphide ore from underground of 25/- per ton. The availability of the oxidised ore has thus been a very important factor in maintaining the payability of the mine.

It has been estimated that to meet present mining costs without taking into consideration the effects of the 40 hour week and the recent award, the grade of underground ore would have to be lifted to 5.5 dwt. per ton. This would reduce the present ore reserve of over 500,000 tons to 370,000 tons, and a number of ore bodies which are at present being mined would need to be abandoned.

In 1947 the cost per ton was 42/6d. with a profit of 8/6d. per ton. The effect of the 40 hour week would probably be to eliminate this profit, and with the prospect of the cutting out of the open cuts in four years time the outlook for economic exploitation of the mine is not encouraging. Unless there is a rise in the price of gold the normal expectation of life on the mine would be the life of the open cut, i.e., 4 years, plus the time required to extract the higher grade sulphide ore which is estimated at an additional 4 years.

With a higher price for gold the life of the mine might be extended for considerably beyond this period. There are on this property, very large tonnages of ore containing from 2 to 4 dwt. of gold per ton. This has been partly developed and tested but at present is not payable.

Competent geologists who have carefully examined the property consider that there are chances of finding

entirely new ore bodies which might prolong the life of the mine for a considerable number of years beyond the period of 8 years given above. However, the lodes discovered on the property to date have been rather small, and the unfavourable "Calc Schist" limits downward extension to the ore bodies at depths varying from the surface at the northern end of the property to 1300 feet at the southern end of the property.

Summary : With the aid of a subsidy the mine has every chance of producing some 35 to 40,000 ounces of gold per year for the next 8 years. After that time continuance of mining operations would depend on new major discoveries, the chances of which at the present time do not appear to be very encouraging.

- (11) BOULDER PERSEVERANCE MINE: The location of this deposit, which is in the heart of the mineralisation, is shown on Plate 1. It has been one of the richest mines on the field but comprises only one lease of 24 acres which has been intensively exploited. The concentration of mining on this deposit is shown on the accompanying plate 2 showing mining carried out at the 500 ft. level. The past production of the deposit as supplied by the operating Company is shown in Table 2. This indicates that from 1896 to 1947 the mine has produced :-

<u>Tons</u>	<u>Fine Ounces</u>
5,205,708	2,706,994

The mine has been exploited to a depth of 2,200 feet indicating that the deposit has yielded to date some 2,300 tons of ore per vertical foot. This is a very high rate of yield and in many respects the mine may be considered to have passed into late maturity. The present rate of production is 138,000 tons annually averaging 5.2 dwt. per ton.

Ore Reserves: The present ore reserves are 358,000 tons averaging 5.29 dwt. This amounts to 2.6 years life at the present rate of production.

The production of gold in 1947 was 33,498 ounces. The productive lodes in this mine have been in the favourable quartz dolerite greenstone, but the unfavourable "calc schist"

passes across the centre of the lease at about the 2200 ft. level, and it has been found that on approaching this contact the formerly highly payable lodes decrease in gold content, and in several instances have become unpayable. However, one lode has been followed into the calc schist and is still payable. It is intended to develop this lode at greater depth.

The present production is maintained from a large number of relatively small lodes which were neglected in the early exploitation of the mine. This requires some 7,000 ft. of development per year which to date has yielded approximately 22 tons of ore per foot developed. This is a reasonably good figure and indicates that the mine is still responding well to exploration. However, the deposit appears to have a definite limit at about the 2200 ft. level and the policy of prospecting more and more intensively the small acreage available must eventually reach a limit. In view of the very intensive mineralisation and of the possibility that new lodes may be discovered near the contact between the favourable and unfavourable rocks, it would be unwise to expect this mine to cut out in the very near future. However it seems unlikely that it will continue beyond a period of perhaps 10 years.

(111) THE HANMAN'S NORTH GOLD MINE (BROKEN HILL PTY. LTD.):

<u>Past Production:</u>	<u>Tons</u>	<u>Fine Ounces</u>
To the end of 1947	353,125	140,543

Yearly rate of gold production - approximately 14,000 fine ounces.

This mine employs approximately 125 men, and mines 4,500 tons of ore per month from which 3,300 tons are selected for milling. As shown on Plate 3 which is a longitudinal section of the ore body, the deposit is limited on the northern end by a large fault which throws the southern portion of the lode outside the limits of the ground held by this Company. The northern end of the deposit is pitched steeply southward so that at No. 13 level the ore body virtually cuts out.

The present ore reserves amount to about 35,000 tons or about 8 months' production, and it may be possible to obtain another 10 to 12 months ore from development and stoping. Thus, as far as

can be seen at present, the life of the mine may be one to two years and the management appears to consider that operations will not be continued beyond this time.

(iv) THE PARINGA MINING & EXPLORATION COY. LTD.:

<u>Past Production</u>	<u>Tons</u>	<u>Fine Ounces</u>
To the end of 1947	830,624	201,514

The capital of the Company is £270,439, ^{sterling} in 1/- shares, and since the commencement of operations from 1935 to August, 1947, the Company paid £258,907 in dividends, and has reserves of approximately £200,000.

The present rate of production is approximately 100,000 tons of ore per year from which is extracted 21,500 ounces of gold. The present ore reserves amount to 240,000 tons, averaging 5.4 dwt. per ton, which is approximately two years' supply.

Future Life: This Company is working on the basis of only 2 years' reserves and has to maintain a very active exploration policy in order to maintain a monthly throughput of 8,000 tons. In the past a good deal of this tonnage was obtained from two major lodes known as the Main Lode and the East Branch. The Main Lode enters North Kalgurli ground below the 640 ft. level and is no longer available for mining by the Paringa. The East Branch lode enters North Kalgurli ground between the 640 and 800 ft. levels and only small tonnages remain to be won from this lode. Strong attempts are being made to maintain production but to date from 61,447 feet of development have produced only 1,001,037 tons of ore, or an average of 17 tons per foot. This figure is rather lower than that for the rest of the field and indicates that the mine has not responded to development as favourably as might have been hoped.

To date, however, the deposit has paid consistent dividends, and the Company's consulting geologist, Mr. K. J. Finucane, considers that there is still much scope for prospecting with very good chances of obtaining very substantial reserves of ore. The Company holds an area of 383 acres and a number of workings have yet to be investigated with a view to developing more ore in their vicinity. However, the Company is faced with an immediate problem to maintain production and ore reserves, and during the 4 weekly period ended

21.1.47 lost \$950 on operations (not including depreciation).

It seems probable that the mine might continue for a period of 4 to 10 years under favourable economic conditions, as it is very likely that a considerable number of small ore shoots still remain to be found. In this regard, however, there is a limit in that the unfavourable Calc Schist rock passes through the leases near the bottom of the present workings. As explained later it is possible that ore will be found below this contact but to date this has not happened. The indications are at the present time that the cost of searching for and mining a sufficient quantity of ore to maintain the mill on full capacity (8,000 tons per month) plus the rise in cost levels are throwing an increasing burden on the economical working of the mine, and it is not unlikely that even with a subsidy this property would cease to produce within a period of 4 to 10 years.

(v) SOUTH KALGURLI CONSOLIDATED:

Past Production: The mines production records indicate that this mine has produced -

	<u>Tons</u>	<u>Fine Ounces</u>
To the end of 1947	2,563,276	1,000,303

The present production is 80,000 tons of ore per year which yields 19,500 ounces of gold.

Ore Reserves: 333,080 tons averaging 4.83 dwt. per ton. Of this total 138,840 tons are probable ore. This reserve will provide about 4 years' life for the mine. Of the total ore reserve, 87,950 tons or 26.4 per cent are above 6 dwt. in grade, but it is doubtful whether this ore could be extracted alone as it is in stopes and lodes along with a larger quantity of lower grade ore. Some 22,500 tons average only 2.7 dwt. and the remainder of the ore reserve lies between these limits.

The lowest mine level is at 2050 feet at which point it intersects the unfavourable Calc Schist rock. The shaft has now been sunk to the 2180 ft. level where preparations are being made to drive and explore the lodes which have passed into the unfavourable rock. A second level below this is under consideration.

During 1947, 4,306 feet of development were carried out which yielded 15 to 20 tons of ore per foot. In addition 2,434 feet of diamond drilling were carried out. During the past 6 months ore reserves

has dropped by 15,000 tons.

Future of the mine: The South Kalgurli lease is a relatively small one and is not in the heart of the mineralisation. In comparison with the Perseverance it has not been a rich mine and has already yielded over two and a half million tons of ore.

The unfavourable Calc Schist enters the east boundary of the lease between 1700 and 1800 feet levels and encroaches on the lease at the rate of 300 ft. horizontally and 400 ft. vertically. The Company is considering the exploration of known lodes which have been payable in the favourable Quartz Dolerite Greenstone where they extend into the underlying Calc Schist. On the basis of the results obtained in neighbouring mines it is considered that this work is not likely to yield highly payable ore.

However, in the past the Company has not adopted a very bold exploration policy, and in the northern end of the lease a considerable volume of the favourable rock remains to be explored from the 500 ft. level downwards. The contact between the Calc Schist and the Quartz Dolerite Greenstone, which in other parts of the field has yielded highly payable sheets, has not been thoroughly explored on this property. A detailed geological examination of the property is now proceeding and it is expected that as a result of this work a proposal will be made to the Board of Directors that an active exploration programme be carried out in order to stabilise the mine.

However present mining costs are about 45/- per ton and the grade of the reserves at 4.83 dwt. per short ton, is under present economic conditions, marginal. In view of the past history of the deposit it is not known whether the Directors will be prepared to gamble on an expensive programme of testing. With the low tonnage which is at present being treated (approximately 6,000 tons per month) it is unlikely that mining costs can be materially reduced, and if a speculative prospecting campaign is undertaken, they may be increased.

Thus although in view of the intensive gold mineralisation at Kalgoorlie there is always a very good chance that high-grade shoots of ore will be encountered which will prolong the life of any mine for an indefinite period, with present prospects it is not improbable that South Kalgurli Consolidated, as a separate entity, will cease

production within a period ranging from 5 to 10 years. Nevertheless, a block of ground in this locality, which in the past has been valuable, will probably be considered as a hopeful prospect for exploration by larger and stronger companies, and the present geologist employed by South Kalgurlie Consolidated considers that there are reasonable prospects of finding a new shoot of the Oroya type which produced some millions of pounds worth of gold, and also that important lodes which have been lost owing to faulting may be rediscovered.

- (2) (1) GREAT BOULDER PTY. MINE: The Company was registered in 1895 with an original capital of £175,000 in 2/- shares.

<u>Past Production:</u>	<u>Tons</u>	<u>Fine Ounces</u>
To the end of 1947	8,448,752	4,880,527

This mine was one of the richest at Kalgoorlie and to date has paid over £8,000,000 in dividends. During the period 1902 to 1927 it paid over £200,000 annually in dividends, and to the end of 1919 paid £5,660,000. From 1920 to 1930 a gradual decline set in owing to the depletion of the main lode system which largely passes into Lake View & Star ground at the 2800 ft. level, and to the gradual rise in mining costs. During this period the mine was partly on tribute.

With the rise in the price of gold in 1930 mining activity increased and it was decided to re-organise the mine. This re-organisation is reflected in the contrast between 1935 production figures and these for 1939:-

<u>Year</u>	<u>Tons</u> (2000 lb.)	<u>Head Value</u> (dwt.)	<u>Recovery</u> (dwt.)
1935	128,990	10.34	8.32
1939	387,890	5.87	5.28

The present rate of production is about 32,000 tons per month, or approximately 400,000 tons per year.

When re-organisation of the mine took place it could be said that the mine had been through its first life, that is the main lode system, and with it the richer ore had been largely exhausted.

In 1938 a programme of intensive lateral development was commenced with the object of testing and opening up for mining, a larger number of lodes which occur apart from the main lode system and which had in the past been considered of minor importance. This lateral testing was so successful that in the period 1938 to 1947 the mine produced 3,614,674 short tons of ore, in addition to which the ore reserves increased by 1,173,371 tons. Approximately 200,000 tons of this ore was won from the main lode system

and the remainder came from subsidiary lodes occurring between the surface and the 2650 ft. level. Thus, in this period the subsidiary lodes have provided about 4,500,000 tons of ore to the 2650 level. To the end of 1939 soon after this programme of lateral development commenced, the production was 5,800,000 tons. Thus the ore yielded from the lateral lodes has been comparable with that obtained from the main lode. The mine has yielded about 25 to 30 tons of ore per foot of development which is a high figure and indicates that the ground is heavily mineralised. However, where the programme of lateral exploration has been completed it can be said that very little opportunity remains for the finding of further probable ore. In these sections of the mine it may be said that the second life of the mine has been completed.

Future of the Deposit: The present ore reserves are as follows:-

	<u>Tons</u>	<u>Grade (dwt.)</u>
Year ended 31.12.1947	2,386,867	5.3

This amounts to approximately 6 years life at the present rate of production assuming that ore of this grade can be mined at a profit. The present bottom level of the mine is at 3100 feet and there is probably sufficient development available between this level and the 2650 level to maintain ore reserves and production for a further 4 to 5 years. The future of the mine will then depend on the grade which will be obtained below the 3100 ft. level. Structurally no major change is expected and the unfavourable Calc Schist contact may not be encountered above a depth of 3500 to 4000 feet. The geologist to the Company has recommended that the Edwards Shaft be sunk below the 3100 ft. level and the Company is reported to be considering the matter. The evidence regarding what is likely to be encountered at depth is as follows :-

- (a) The mine has been immensely rich in the past
- (b) The important 16, 17 and 18 lodes dropped below payable grade at the 2950 and 3100 ft. levels
- (c) Fragmentary information obtained from Lake View & Star Co. indicates that there is a very definite but gradual fall in grade from about the 2000 ft. horizon downward on the west lode system.

- (d) The considerations listed in the final section of this report including the evidence shown on Plates 4 and 5 show that there is a zoning in gold distribution at Kalgoorlie, and that a fall in grade is to be expected with deeper levels.

Nevertheless, there is every warrant to testing the downward extension of the known ore bodies on the Great Boulder and with the evidence now available it is not possible to state that ore ranging from 4 to 6 dwts. per ton will not be obtained. On the other hand, there is the possibility that, if factors such as the price of gold remain unfavourable, the present high rate of production (400,000 tons per ^{year} month) could not be maintained beyond a period of approximately 10 years.

- (11) KALGOORLIE ENTERPRISE MINES LTD.: This property is wholly owned and managed by the Boulder Perseverance Gold Mine.

Mining commenced in 1938. The present maximum depth of working is 2200 ft. The property had previously been worked by a syndicate to a depth of 500 ft. The present output is 5,000 tons per 4 weekly period.

The lodes in this property will not be cut off by the unfavourable Calc Schist rock above a depth of 3000 ft. and there is no immediate prospect of the exhaustion of the ore supplies. However the lode system is a limited one and it is doubtful whether production will ever exceed the present figure of approximately 5000 tons per month.

<u>Ore Reserves:</u>	<u>Tons</u>	<u>Dwt.</u>
	310,000	6.21

The total production to the end of 1947 is :-

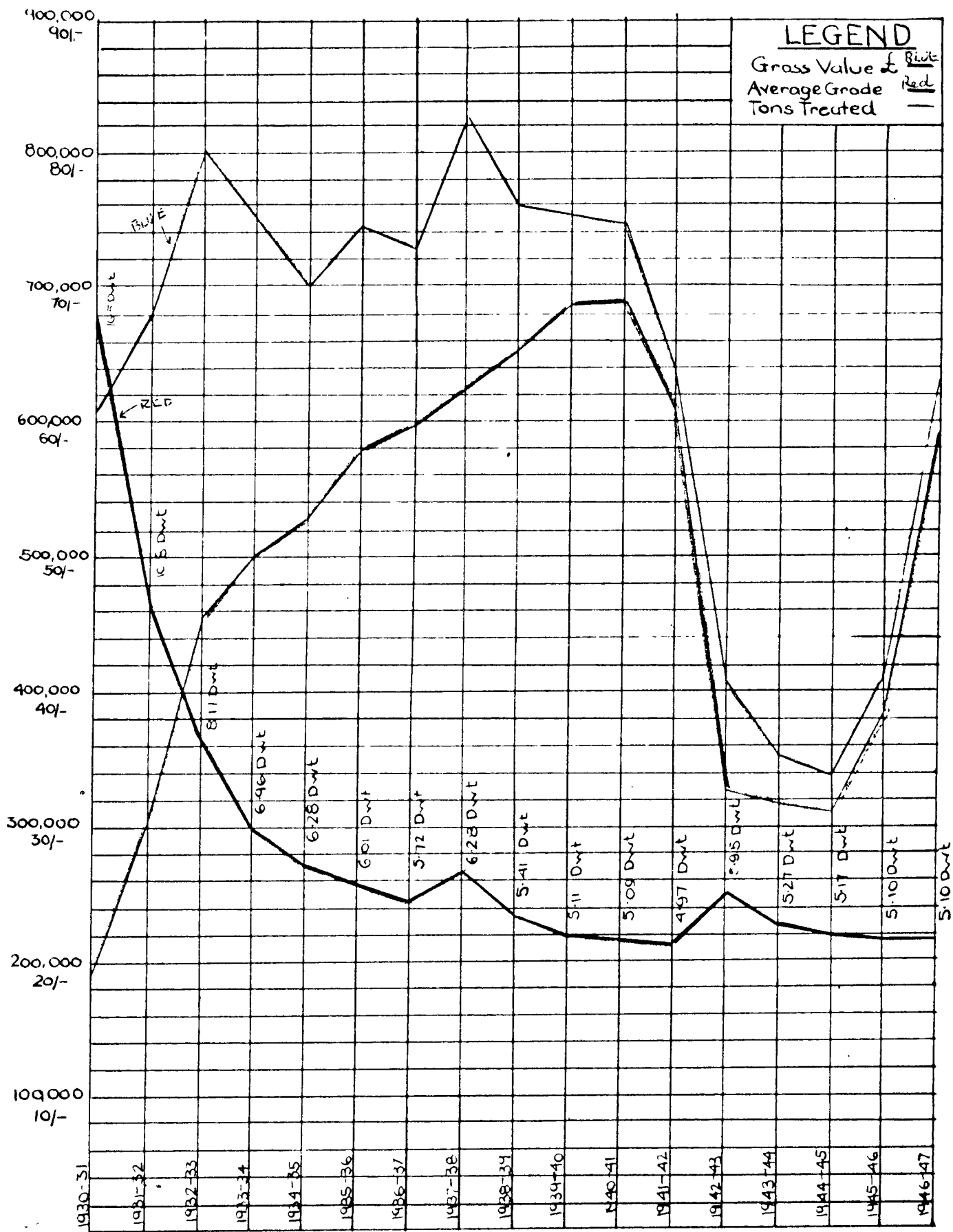
<u>Tons</u>	<u>Fine Ounces</u>
546,973	169,993

The gold output for 1947 was 17,800 ounces.

- 3) (1) LAKE VIEW & STAR LTD.: This property comprises a number of formerly important mines which were amalgamated in 1930. ^{Post production} Prior to amalga-
~~mation the properties had produced :-~~

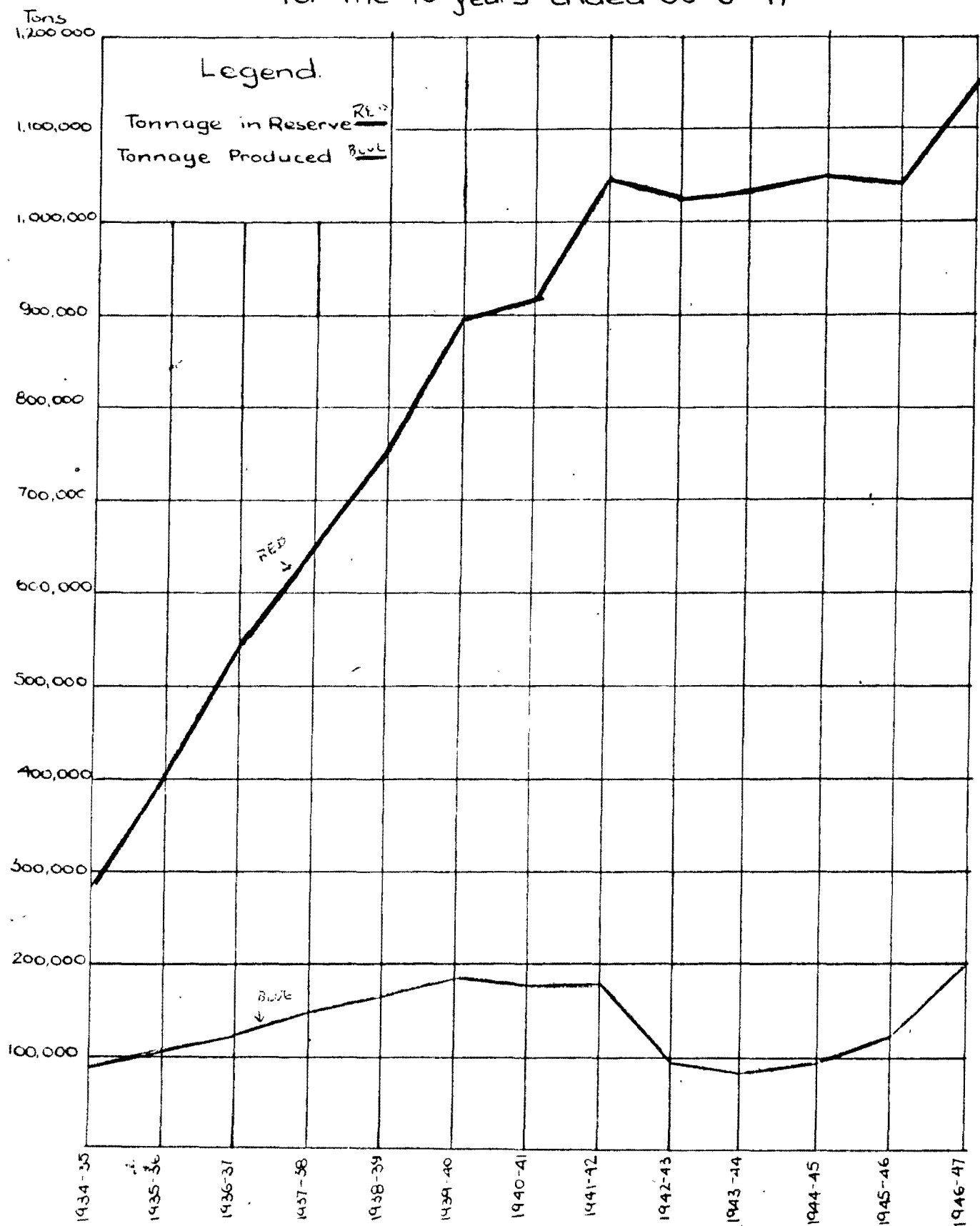
	<u>Tons</u>	<u>Fine Ounces</u>
Prior to Amalgamation	15,792,500	9,149,232
Production since Amalgamation	<u>7,741,145</u>	<u>2,591,209</u>
	<u>23,533,645</u>	<u>11,730,441</u>

Graphic Representation of Production for 17 years ended 30-6-47 showing Tons Treated, Gross Value and Average Grade



Lake View and Star Ltd.

Graphic Representation of the Tonnage in the Ore Reserve Estimates and the Production from the Minor Lodes for the 13 years ended 30-6-47



Lake View and Star Ltd.

The present rate of production is about 600,000 tons of ore per year from which is produced approximately 150,000 ounces of gold per year.

Ore Reserves: The present ore reserves are :-

<u>Tons</u> (2000 lbs.)	<u>Dwt.</u>
3,601,600	4.80

This reserve may be segregated as follows :-

<u>Plus 10 dwt.</u>		<u>7.5 to 10 dwt.</u>		<u>5 to 7.5 dwt.</u>		<u>3.5 to 5 dwt.</u>	
<u>Tons</u>	<u>Dwt.</u>	<u>Tons</u>	<u>Dwt.</u>	<u>Tons</u>	<u>Dwt.</u>	<u>Tons</u>	<u>Dwt.</u>
8,700	11.45	113,500	8.16	1,168,100	5.74	2,310,600	4.14
% of whole 0.24		3.15		32.45		64.16	

Figure 1. is a graphic representation of production over the past 17 years.

This reserve amounts to 6 years life at the present rate of production.

Future of the Deposit: There is no sign as yet of the depletion of ore reserves on this property. Many of the main lode systems in the favourable quartz dolorite greenstone still remain to be developed above the present bottom level, and there is every indication that these lodes will produce ore sufficient to maintain reserves for some years ahead. In addition to this it may be said that the Lake View & Star property is still to a large extent in the first stage of its life, i.e. lateral exploration of the minor lode systems such as that described for the Great Boulder Pty. Mine has not yet been extensively undertaken, although sufficient work has been done to indicate the strong probability that when this exploration is undertaken, large additional quantities of ore will be obtained. This is indicated by Figure 2, which is a graph showing the marked increase in ore reserves in the so called minor lodes despite an increase in production from these lodes from 100,000 tons to 200,000 tons per annum. It appears very likely that without carrying the present workings to any greater depths sufficient ore could be obtained to maintain the present rate of production for perhaps a further 15 years.

The main lode systems have been developed to depths of 3260 feet, 3390 feet, and 3670 feet respectively, although the extent of driving on the bottom levels is not very

great. The problem of the extension in depth of these lodes is dealt with under the section on the future of Kalgoorlie.

(11) NORTH KALGURLI (1912) LTD.:

<u>Past Production:</u>	<u>Tons</u>	<u>Fine Ounces</u>
(Present Company only)	1,898,242	660,203

A very considerable production was obtained from these leases prior to their consolidation under the present Company. These figures have not yet been obtained.

The present rate of production is approximately 150,000 short tons of ore per year which yields approximately 45,000 ounces of gold. It is anticipated that early in 1949 the rate of production will be stepped up to 220,000 tons per year.

Ore Reserves: The present ore reserves are :-

<u>Tons</u>	<u>Dwt.</u>	<u>Fine Ounces</u>
1,548,385	6.02	466,347

Eliminating all ore below 5 dwt. per ton the reserve is :-

<u>Tons</u>	<u>Dwt.</u>	<u>Fine Ounces</u>
1,279,415	6.37	407,375

The Company thus has approximately 6 years ore reserves at the anticipated increased rate of production, and there are a large number of lodes on the property which are known but which await development and are not included in the above reserve. Most of the ore is being obtained from depths ranging up to 1,000 ft. only and there is still much scope for prospecting in depth. The property contains very large reserves of lower grade ore which are at present being left. With an increase in the price of gold for example the mine would be capable of a very much larger production than that obtained at present. It is not practicable to hazard an opinion as to the life of this mine but it is considered very likely that there will be no difficulty in obtaining ore of the present grade and at the present rate of extraction for the next 15 or 20 years.

THE VARIATION OF GRADE WITH DEPTH AT KALGOORLIE:

Plates 4 and 5 indicate graphically the vertical distribution of gold on the eastern and western lode systems respectively as it was known in 1935. Since that time much more ore has been exposed in the deeper levels

and probably the present picture would be somewhat altered. Nevertheless Mr. J.C. Campbell, Chief Geologist for the Western Mining Corporation, who has made a particular study of this matter considers that in general the distribution shown on these plates is basically correct. The plates indicate that on the east lode system the richest ore tended to die out at some 800 to 1000 ft. below the surface, while on the west lode system there was a marked drop in grade at approximately the 2000 ft. level (800 ft. below sea level).

Supporting evidence for this distribution obtained for the east lode system is shown by the records of dividends paid by Companies exploiting lodes in this area. These records show that a number of these mines became unprofitable in the period 1909 to 1913 when they had passed through the rich upper zone. In a general way this fact is revealed on the Chamber of Mines graph (Plate 6.) which indicates that the period 1900 to 1910 was the heyday of the field when large tonnages of ore ranging from 10 to 20 dwt. were obtained, and when dividends reached a rate of over two million pounds per annum, which rate has never subsequently been obtained. The revival of the field from 1930 to 1940 is a reflection of the increased price of gold and of more efficient methods of mining.

Owing to the fact that they operate the deepest mines at Kalgoorlie, the Lake View & Star Coy. has the most complete records of the variation of grade with depth. However these records are rather a closely guarded secret and in addition this Company is at the present time operating at a substantial profit and consequently has not been included in the proposed scheme for subsidising the goldmining industry. However the following information has been obtained :-

On number 4 lode which is a major deposit the following variation of the grade of ore reserves with depth is noted :-

	<u>Grade of Reserves</u> <u>Dwt. - (Short ton)</u>
From No. 37 to 36 levels	3.96
From No. 36 to 35 levels	4.07
From No. 35 to 34 levels	4.52
From No. 34 to 33 levels	5.93
From No. 33 to 32 levels	6.17
From No. 32 to 31 levels	5.39
From No. 31 to 30 levels	5.18

From 30 to 29 levels	5.20
From 29 to 28 levels	4.61
From 28 to 27 levels	4.75

For No. 2 lode the grade of reserves is as follows:-

Grade of Reserves <u>Dwt. - (Short ton)</u>	
Between the 3400 and 3300 levels	3.93
Between the 3300 and 3200 levels	3.96
Between the 3200 and 3100 levels	3.72
Between the 3100 and 3000 levels	4.28
Between the 3000 and 2900 levels	4.00
Between the 2900 and 2800 levels	3.84
Between the 2800 and 2700 levels	3.77
Between the 2700 and 2600 levels	4.73
Between the 2600 and 2500 levels	4.71
Between the 2500 and 2400 levels	5.89
Between the 2400 and 2300 levels	8.95
Between the 2300 and 2200 levels	5.20

An analysis of the production from this lode has shown that the grade varies at a relatively constant rate from 5.68 dwt. at the 2000 ft. level to 4.24 dwt. at the 3400 ft. level. The amount of information obtained is not conclusive but it is considered likely that within the favourable quartz dolerite greenstone rock the main lode systems persist to depths considerably exceeding 3500 ft. depth, and that their grade is likely to be of the order of 4 dwt. when mined on a sufficient scale to maintain present rates of production. Some very rich ore has been obtained on these levels but the available evidence suggests that the frequency of occurrence of these shoots is lower than was the case in the upper levels of the Kalgoorlie field.

It is considered that the grade fluctuation with depth at Kalgoorlie is to be expected because it appears very likely that the deposits originated during a period of volcanic activity, and that essentially their origin is somewhat related to the Cripple Creek type of mineralisation in which a fairly rapid depth grade variations is a marked feature. Dr. R.T. Prider has carried out a good deal of petrological work on Kalgoorlie Metasomatism and considers that ^{it} essentially similar to

the alteration known at Waihi, New Zealand, where the ore deposits are related to volcanic activity. Nevertheless the Kalgoorlie Field was deposited at a relatively higher temperature than the normal deposits of volcanic origin and possibly for this reason the depth-grade fluctuations have been less marked at Kalgoorlie than in most other fields of a similar type.

There is no evidence that the drop in grade with depth is going to effect production at Kalgoorlie within the next 10 years because the mines which are concerned with this problem, namely the Great Boulder Pty. and Lake View & Star Ltd., are in a relatively strong position for ore reserves each having about 6 years life of proved ore alone. It is thought that some of the companies will take the view that before it is necessary to exploit the probable lower grade ore at depth, the general economic position will have been greatly clarified. *There are also reasons for believing that the occurrence of a new wave of high-grade gold at depth is not impossible.*

In considering the future life of Kalgoorlie, however, the depth-grade variation is only one of the factors on which the future of Kalgoorlie depends. The gold metallisation on this field has been most unusually intense and during the past 10 years it has been shown that wherever exploration is intelligently directed new lodes of payable grade are found. Plate 7 illustrates a major discovery of this nature on the North Kalgoorlie Mine which shows the great possibilities which still remain at Kalgoorlie. This discovery is in itself sufficient to maintain a 10,000 ton a month mine in production for some years, and in addition to that it lies within the Calc Schist rock which had formerly been considered unfavourable because the main lodes from which production was formerly obtained did not normally extend into this rock. The discoveries shown on Plate 7 plus numerous other similar lodes found at or near the contact between the favourable and unfavourable rocks indicates that there is much scope for further prospecting of this contact, which in the past has produced such shoots as the Oroya. In addition it is not at all unlikely that entirely new series of ore shoots may be obtained near the junction of dissimilar rock types well within the Calc Schist which in the past has been considered unfavourable. There is ample scope for exploration of this section of the field well within the range of the temperature zone over which gold deposition has occurred.

At the southern end of the Kalgoorlie field the Western Mining Corporation are carrying out a drilling programme in an attempt to locate a

possible complete repetition of the Kalgoorlie mineralisation. The chances of success here may be considered to be of the order of 1 : 50, but should a success be obtained the effect on the life of the field could be very important. There is not the slightest doubt that the known intensity of metallisation at Kalgoorlie will stimulate the search for further deposits for many years to come. This search will undoubtedly result in the discovery of additional ore shoots, and it is not at all impossible in a field such as Kalgoorlie that a discovery will be made which will change the whole outlook for the future.

B. THE BIG BILL MINE.

This orebody is one of the largest individual deposits in Western Australia. The length is 1,500 feet, average width 64.25 ft. which dimensions yield 7,420 long tons of ore per vertical foot. Of this 4,500 tons are recovered, the remainder being left as pillars to support the workings.

The average grade after allowing 5 per cent for dilution is 3.02 dwt. per ton which corresponds to the present head value; from this is extracted 2.67 dwt. which is equivalent to 28/8 per ton.

The present output is 35,000 tons per calendar month.

The ore reserves at January 1947 were as follows -

	tons	Assay value	T x A	Life (years)
Developed ore	1,900,000	2.92	2,926,645	
Probable ore	940,600	3.09	2,911,159	
Prospective ore	374,700	3.10	1,160,446	
Grand total	2,315,200	3.02	6,998,250	5.6

On this mine developed ore is equivalent to extractable, proved and blocked out ore after allowing for pillars which have to be left. Probable ore is blocked out on two sides and also includes pillars which may be extractable. Prospective ore consists of a 50 ft. extension in depth of the lower perimeter of the known ore. This figure is quite arbitrary and is a very safe one.

The ore reserves at January 1948 have not yet been calculated but it appears that there has not been any marked alteration in the position.

Development on this mine has to date been confined to the known orebody and cannot in any way be regarded as exploration. There are areas to the south of the deposit at present being worked which it is intended to test but to date no exploration has been carried out in this direction.

On this mine, levels have been driven at vertical depths of 253 ft., 433 ft. and 613 ft. The company is at present developing and preparing for stoping on the No.4 level (vertical depth 613 ft.) which is the lowest level at which ore extraction is taking place. Two winzes are down to the horizon of No.5 level (vertical

depth 800 ft.) and two other winzes have been extended for 130 ft. below the 613 ft. level. Seven drill holes have been bored from these winzes and the holes have revealed continuity of values and widths. The shaft has been sunk to 1,000 ft. in the footwall of the lode and a bore hole drilled from the bottom of the shaft revealed average grade and width.

The Future of the Deposit - It was not possible to visit this deposit but from the information supplied by the company's geologists it appears that the mine should be regarded as being in its early youth. The present ore reserves are sufficient to supply the mill at the present rate of production for 5.5 years. There is every indication that the orebody extends to 1,000 ft. which would be sufficient to supply ore for another 2.5 years. The orebody contains high temperature minerals such as pyrite, chalcopyrite, molybdenite, rutile, echcelite, tourmaline, garnet and andalusite. It is apparently genetically related to pegmatite dykes and if there had been any significant increase in the number of these dykes present some alarm for the future of the deposit may have been warranted. However, to the 1,000 ft. level there appears to be no change in the character of the orebody and on present knowledge it may be assumed that the deposit will extend in depth well below the 1,000 ft. level. Each 100 ft. of extension in depth supplies a little over a years ore requirements.

Possibility of selective mining - By excluding all ore below 3 dwt. in grade it is possible to delineate two lenses which in aggregate amount to approximately 60 per cent of the lens which is at present being mined. The grade of these two lenses is approximately 3.75 dwt. per ton. If it was attempted to mine these selectively the whole mine lay-out would require to be modified and in addition it would be difficult to ^{the} attain present rate of production. It seems more than likely that the slight increase in grade would be more than offset by the cost of reorganisation and by the loss in production.

C. SUNDRY SMALL MINES.

(1) ORA PANDA AMALGAMATED

At present it seems unlikely that this mine will come

into production until there is a change in economic conditions, i.e. either a rise in the price in gold or a reduction in the present price level.

(2) EMU MINE, AGNEW

This deposit has recently been worked at the rate of 2,000 tons per month, but this operation is quite uneconomic. The deposit is of impressive size and warrants testing by a strong organisation with a view to finding out whether it will sustain a mine with a production of 20,000 to 30,000 tons per month.

(3) PHOENIX MINE, COOLGARDIE

This mine has had a very precarious existence since 1937. Present ore reserves amount to approximately 20,000 tons averaging 5 dwt. which is less than a years ore supply. During 1943-44 no development work whatever was undertaken and in 1945 development amounted to only 374 feet. For a mine of this nature 3,000 to 4,000 feet of development per annum are necessary to obtain production in ore reserves, but the management has not had sufficient revenue from production to maintain the mine in a healthy position. In any case the deposit consists of a number of small lenses which have been extensively faulted and it appears unlikely that the mine will be able to carry on for very much longer.

(4) SONS OF GWALIA

The mine was visited for a brief period only. It was intended to spend three to four days at this important deposit which has been a consistent producer for the past 50 years and has probably been the most outstanding Western Australian gold mine outside of Kalgoorlie; however, owing to the aerodrome being put out of action by heavy rain it was not possible to return to the mine. In the past the grade of the ore has been most consistent over an inclined depth of more than 5,000 feet and it is logical to assume that ore of past grade will continue in depth.

(5) BURRIDGE GOLD MINES LIMITED

Production in 1947 was 2,153.07 fine oz. This deposit

... was not visited during the present inspection but a report by Mr. L.C. Olive, District Inspector of Mines, is attached. The ore is a lateritic surface deposit which is suitable for open cutting. Preparations are being made to mine the deposit at a rate of 6,000 tons per month. The average grade is 1.6 dwt. per ton and the overall cost per ton on a lower rate of mining was 16/2. It is hoped to reduce this cost to 10/- per ton. The Western Australian Government has reduced the cost of water supply to the company from 4/6 per 1,000 gallons to 2/6 per 1,000 gallons. The Company is reported to be a sound one and is undertaking a rather difficult operation which deserves to be encouraged.

(6) RADIO GOLD MINING LEASE, SOUTHERN CROSS

This mine has been worked for some years by Messrs. Barr and Clements and has yielded very substantial profits. It does not require a subsidy. The production for 1947 was 1,017.73 fine oz.

(7) EDWARDS SUNSHINE REWARD AMALGAMATED MINE.

This mine is situated 27 miles south of Southern Cross. The production in 1947 was 1,386.58 fine oz. The mine is worked by a syndicate all of whom are employed on the mine. Quartz reefs 18 inches to 12 feet in width have been worked over a length of 1,100 feet to a depth of 200 ft. Past production was -

<u>Ore</u> <u>tons</u>	<u>Gold</u> <u>fine oz.</u>
21,092	10,678

Present ore reserves -

<u>Ore</u> <u>tons</u>	<u>Grade</u> <u>dwt.</u>
33,900	8.66

The mine is being reorganised for a production of 1,000 tons per month. It has been recommended that the State Government advance £15,000 to carry out plant modifications to enable this production to be attained. Costs for the 12 months to May 1947 were 53.27/- per ton, but it is estimated that at the increased rate of production overall costs would be 43/7 per ton.

As this mine has not yet come into production at the increased rate, the actual cost of producing an ounce of gold has not yet been ascertained and it is unknown whether the mine will require a subsidy.

(8) NEW BREW MINE, BREEKATHARRA

Production for 1947 was 1,437.82 fine oz. This mine employs 10 men who are working on a tribute basis. The grade varies from 1 to 2 oz. per ton and no subsidy is required.

(9) MOUNT IDA MINE (Gold Fields Australian Development Co. Ltd.)

Production for 1947 was 1,450.37 fine oz. This mine at present employs 40 men but at present is being regarded as a prospect to be tested with very favourable chances of producing 2,000 tons per month. The management considers that it is unlikely that the mine will need any form of subsidy. The average grade is approximately 10 dwt. per ton.

(10) EVANSTON GOLD MINE, N.L.

Production for 1947 ^{was} 4,914.19 fine oz. This mine is at present out of production and it is unlikely that the deposit will be reopened. The late manager considers that the profitable ore has been exhausted.

C. J. Sullivan
(C.J. Sullivan)
Superintending Geologist.

CANBERRA.
3/3/48.

TABLE I.
GOLD MINES OF KALGOORLIE LTD.

Particulars of Tonnage Milled, Ore Reserves, Development Footage and Ore Developed per Foot.

From Financial Year ended 31/3/37 to Financial Year ended 18/3/47.

<u>Year Ended</u>	<u>Tonnage</u> (2,400 lbs)	<u>Mill Head</u>		<u>Ore Reserves</u>		<u>Development Footage</u>		<u>Ore Developed for</u> <u>Year i.e. Tonnage</u> <u>Milled + Ore</u> <u>Reserve Fluctuation</u>	<u>Tonnage</u> <u>Developed</u> <u>per foot</u> <u>of</u> <u>Development</u>
		<u>Dwts.</u>		<u>Tons</u>	<u>Av. Grade</u> (Dwts.)	<u>Development</u>	<u>Diamond Drilling</u>		
31st March '37	18945	14.1	+	266000	7.3	5544	7947		
31st " '38	46009	9.6		371700	6.6	7803	7282	151709	19.4
31st " '39	103261	7.2		670000	5.2	6190	8143	401561 x	64.9
31st " '40	123119	6.91		657000	5.1	6032	8922	110119	18.2
25th " '41	161240	6.58		646000	5.0	6480	8171	152240	23.5
24thb " '42	158793	5.66		610550	5.0	6438	8977	123343	19.2
23rd " '43	139936	5.14		553670	5.2	4246	3012.5	83056	19.6
21st " '44	79709	5.23		536670	5.7	5135	4885.5	62709	12.2
20th " '45	104353	5.29		531920	5.3	6174	6204	99603	16.1
19th " '46	116601	5.2		526660	5.1	7378	4929	111341	15.1
18th " '47	156053	5.14		547978	5.2	6386	10760	177371	27.8

x This figure includes the open cut ore reserves for the first time.

+ This figure represents yield only at old associated treatment plant.

TABLE 2.

BOULDER PERSEVERANCE LIMITED

RECORD OF PRODUCTION

Year	Tons	Ozs.	Av. re- covered dwts.	Main Shaft Depth	Remarks
1900	43,297	48,102	22	700	Au from retreatment tailings incl.
1901	108,355	134,219	25		" " " " "
1902	140,642	193,383	27	900	" " " " "
1903	132,593	213,180	32	1135	" " " " "
1904	135,638	135,559	20	1300	" " " " "
1905	165,465	104,697	12.6	1476	
1906	169,194	80,649	9.5	1626	
1907	199,958	80,927	8.1		Ore mainly from 700 & 900 ft.
1908	204,406	71,025	7.0	1922	levels.
1909	192,173	70,680	7.4		
1910	91,852	27,013	5.9	2190	Low tonnage due to destruction
1911	243,109	72,415	6.0	2228	of plant by fire.
1912	234,636	62,932	5.4		
1913	244,841	59,451	4.9		
1914	245,555	61,150	5.0		
1915	239,314	57,896	4.8		Development work suspended &
1916	194,106	48,215	5.0		commenced drawing B.O.R.
1917	153,357	38,699	5.1		Gt. Bldr. Perseverance in
1918	161,139	48,352	6.0		liquidation.
1919	44,408	37,260	17		Short tons to and including 1920, long tons thereafter.
1920	44,656	51,415	23		
1921	43,160	48,193	22		
1922	37,349	41,581	22		Tributing - selective mining in extreme form.
1923	37,265	44,390	24		
1924	54,569	54,733	20		1923 B. Perseverance Ltd. formed.
1925	45,829	26,500	16		
1926	59,129	44,614	15		
1927	58,260	38,777	13		
1928	49,616	27,403	11		
1929	72,193	33,130	9.1		
1930	66,182	29,920	9.1		
1931	69,628	33,664	9.7		Exchange rates 25%.
1932	72,019	29,764	8.3		
1933	66,881	28,687	8.5		
1896-1933	3,806,215	2,266,115	12 dwts.		Converted to Long Tons.
			Av. Head Value		
1934	68,916	24,636	8.6		
1935	69,807	25,270	8.7		
1936	93,945	33,797	8.2		
1937	109,957	42,024	8.3		
1938	111,824	40,877	7.7		
1939	114,567	37,569	7.0		
1940	116,181	37,332	6.8		
1941	120,923	37,385	6.6		
1942	106,961	32,433	6.5		
1943	82,052	22,962	6.0		
1944	76,328	20,564	5.8		
1945	86,772	23,561	5.8		
1946	103,059	29,139	6.1		
1947	138,201	33,330	5.2		
1934-1947	1,399,493 3,806,215	440,879 2,266,115			
1896-1947	5,205,708	2,706,994			Average recovery per ton - 10.5 dwts.

Note: Ore from Boulder Perseverance lease only.
Great Boulder tribute not included.

KALGOORLIE.

23rd December 1947.

State Mining Engineer,
Mines Department,
PERTH, W.A.

re BURBRIDGE GOLD MINES LIMITED.

I have investigated the application of the above company for a cheaper water rate and report as follows -

This Company which is located 28 miles South of Southern Cross holds several mining leases comprising the Great Victoria, The Grand National and the Branco leases.

There is a big tonnage of gold-bearing laterite and several wide low grade oxidised ore bodies on these leases, and it is this ore that the Burbridge Company is mining and treating.

The Company's mill is located on the Great Victoria Lease and up to the present plant to the value of £28,750 has been installed. This plant is now capable of treating 2,500 tons of ore per month, but with an additional expenditure of £7,000 the tonnage will be increased to 6000 tons per month. The plant required for this increased tonnage is already on the mine to be installed.

This mine was closed down during the latter years of the war and it is taking the company some time to get back to normal production of 3,500 tons per month owing to the deterioration of a big percentage of the leaching vats.

The mining operations for the past twelve months to the 31st October were confined to the laterite on the Grand National Lease. The ore is excavated by a cubic yard diesel shovel and carted by 5 ton trucks approximately 1 mile to the mill. A total of 25,392 tons were obtained and treated for a recovery of 2,034 fine ounces of gold. The working costs for this tonnage not including Head Office expenses were £20,649. It is apparent from these figures that the profit over the period was nil.

As I have already stated the ore reserves are high but very low grade. Those on the Great Victoria Lease being estimated at 700,000 tons of an average grade of 1.60 dwts per ton. The tonnage of the Grand National and Branco Mines is even greater and of a little higher grade. The estimated life of the mine from all sources is 10 years, treating 6,000 tons of ore per month.

The average costs of producing gold over the past 12 months have been 16/2 per ton of ore treated, but this cost has been lower over the past two months. To reduce the costs the company are installing the necessary plant to treat 6000 tons of ore per month and by this method they hope to mine and treat the ore for 10/- per ton.

From the figures already quoted, we see that this mine is treating the lowest grade of ore, of any mine in the State, and are doing an excellent job, on what was generally considered worthless gold bearing material, and not ore. To carry on treating this ore and profitably producing gold it is necessary for the company to cut all costs to the absolute minimum, and, also obtain any small concessions that may be available from any course.

It is not the intention of the Company to seek a Government Loan, but they have asked for a cheaper water rate, that is a reduction from the present rate of 4/6 per thousand gallons to 2/6 per thousand gallons. This is not a big concession since the

cost of water over the past twelve months was £456.

When the tonnage is increased from 2000 to 6000 tons per month on 72,000 tons per annum the company will use approximately 5,760,000 gallons of water per annum, allowing 80 gallons of water per ton of ore treated. A reduction of 2/- per 1000 gallons on this quantity would mean a saving of £576 in costs over twelve months, a big item to a struggling company.

The Company has spent some £28,750 in plant and buildings on the mine and at the present time keep 22 men directly employed. There is no doubt that the mine is an acquisition to the district and the industry generally.

After careful consideration to this matter I recommend that, if it is at all possible, the following concessions should be given to the Burbridge Gold Mines -

The water supplied to the Company by the Goldfields Government Water Supply Board should be charged for at a sliding rate, depending on the average value of the ore treated as follows -

1. 4/6 per thousand gallons for the treatment of all ore over 3 dwt. per ton.
2. 3/6 per thousand gallons for the treatment of all ore over 2.25 dwt. and under 3 dwt. per ton.
3. 2/6 per thousand gallons for the treatment of all ore under 2.25 dwt. per ton.

I consider that this Department should assist any Company that is prepared to finance and work a mine in the same manner as the Burbridge Gold Mines.

(Sgd.) L.C. Olive.
District Inspector of
Mines.