1950

LEAD MINE
PROTHEROE, WESTERN AUSTRALIA

Report of the

DEPARTMENT OF MINES

WESTERN AUSTRALIA

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

1953

—

WESTERN AUSTRALIA

REPORT

of the

Department of Mines

FOR THE YEAR

1950

Presented to both Houses of Parliament.

PERTH:
By Authority: WILLIAM H. WYATT, Government Printer.

1953.

61224/2/53.

ANNUAL REPORT OF THE DEPARTMENT OF MINES, WESTERN AUSTRALIA, 1950.

TABLE OF CONTENTS.

DIVISION I.

DIVISION II.

DIVISION III.

DIVISION IV.

DIVISION V.

DIVISION VI.

DIVISION VII.

DIVISION VIII.

DIVISION IX.

DIVISION X.

STATE OF WESTERN AUSTRALIA.

Report of the Department of Mines of the State of Western Australia for the Year 1950.

To the Hon. Minister for Mines.

Sir,—I have the honour to submit the Annual Report of the Department for the year 1950, together with reports from the officers controlling sub-departments, and comparative tables furnishing statistics relative to the mining industry.

I have etc.,

A. H. TELFER,
Under Secretary for Mines.

Perth, 3rd April, 1951.

Division I.

The Honourable Minister for Mines:

I have the honour to submit, for your information, a report on the mining industry for the year 1950.

The estimated value of the mineral output of the State for the year was £4,616,157 (calculating gold at £4 4s. 11.45d. per fine ounce), an increase in value of £195,330 compared with the preceding 12 months. The estimated value of the premium paid to gold producers amounted to £A6,873,740, bringing the gross value of all minerals to £A11,489,897, an increase of £A1,860,597 compared to the 1949 production.

There were increases in quantities and values of antimony, chrysotile asbestos, barytes, bentonite, calcite, coal, copper fertiliser, dolomite, felspar, glass sand, glauconite, gypsum, ilmenite sand, iron ore, manganese, mica, ochre, pyrites, talc, tantalo-columbite and tin, and decreases in quantities and values of alunite, arsenic, beryl, clays, copper ore, diatomaceous earth, kaolin, lead ores and concentrates, magnesite, petalite, tungsten and vermiculite. Crocidolite asbestos showed a slightly decreased quantity but a higher value.

The estimated value of gold received at the Perth branch of the Royal Mint and exported in gold-bearing material was £A9,466,270 (and equalled 82.39 per cent. of all minerals). (See footnote to Table 1 (a), Part II).

Others minerals realised: Coal, £1,287,749; pyrites, £163,514; asbestos, £152,678; lead ores and concentrates, £111,648; iron ore, £82,682; silver, £59,644; manganese, £65,459; tin, £25,496; gypsum, £21,942; Cupreous ore (fertiliser), £8,867; glauconite, £8,735; felspar, £5,329; clays, £4,936; magnesite, £3,825; glass sand, £3,566; antimony, £3,514; tantalo-columbite, £2,858; talc, £2,700; red ochre, £1,860; alunite, £1,822; beryl, £1,431; dolomite, £1,268; vermiculite, £720; bentonite, £599; ilmenite sand, £521; copper, £183; barytes, £56, and calcite, £25.

Dividends paid by mining companies amounted to £1,196,088, an increase of £352,306 when compared with the previous year (see Table 6, Part II).

To the end of 1950, the total amount distributed by gold mining companies was £46,227,963. To the same date the progressive value of the mineral production amounted £255,063,518, of which gold accounted for £227,093,964 based on normal values; but premiums on sale of gold during years 1920-1924, plus payments under the Gold Bounty Act, 1930, and further premiums by virtue of enhanced value, increase the total value of gold and mineral productions by £88,165,789, making a gross value of £A343,229,307.

GOLD.

The quantity of gold reported as being received at the Perth branch of the Royal Mint (606,171.88 fine oz.) together with that contained in bullion, concentrates, and other gold-bearing materials exported for treatment (4,161.53 fine oz.) totalled 610,333.41 fine oz., and failed to equal that of 1949 by 38,092.21 fine oz. (vide Table 1 (a) of Part II).

Similarly, the total gold yield for the year reported directly to the Department by the producers was 608,633.36 fine oz., which constituted a decrease of 40,938.71 fine oz. in comparison with the previous year's figures. (Vide Table 3 of Part II).

The slight variance between the two totals mentioned above is principally due to the fact that the gold reported as being received at the Mint and exported for treatment is not all necessarily produced during the calendar year under review, a certain quantity being in the transitory stage from the producer at the end of the year. The former total is accepted as the official production of the State on account of its realised monetary value, whilst the latter is utilised mainly in tracing the gold back to its source, i.e., individual mine production to which a respective ore tonnage can be applied. The calculated average value per ton of ore treated in the State as a whole showed a further decline from 22.357 shillings per ton in 1949 to 20.990 shillings per ton in 1950, calculating gold at the old rate of £4 4s. 11.45d. per fine oz., but the premium rate, which remained unchanged throughout the year (264.70 per cent.), would more

than treble this estimate. For East Coolgardie Goldfield (which produced aproximately 67 per cent. of the State's yield of gold), the calculated average value ore treated decreased from 22.601 shillings to 20.862 shillings per ton. The estimates for Murchison (Big Bell Mines Ltd. and Hill 50 G.M. N.L.), Mt. Margaret (Sons of Gwalia Ltd.), Coolgardie (New Coolgardie G.M.'s N.L.), and Dundas (Central Norseman Gold Corpn. N.L.) were 14,100s. (14.216s.); 28.436s. (31.655s.); 37.797s. (28.134s.); 23.430s. (30.289s.) respectively. Figures for 1949 are shown in parenthesis.

The tonnage of ore reported to have been treated in 1950, viz. 2,463,423 tons, was 4,874 tons less than the previous year and constituted 57.40 per cent. of the State record tonnage established in 1940.

The following tonnage increases were reported from the respective Goldfields:—Pilbara 4,237, Peak Hill 557, East Murchison 1,280, Mt. Margaret 6,865, North Coolgardie 13,304, East Coolgardie 18,023, Coolgardie 5,744, and Dundas 21,973; whilst those fields in recession were West Pilbara by 385, Ashburton 210, Murchison 73,048, Yalgoo 656, Broad Arrow 1,443, North-East Coolgardie 349, Yilgarn 501, and Phillips River 278 tons.

In the East Coolgardie Goldfields, five of the nine principal companies on the Golden Mile showed an aggregate improvement of over 44,000 ore tons, principally due to the 24,700 ton increase effected by the Lake View & Star Ltd., but the regression of the other four companies reduced it to a net gain of only 18,000 tons for the year.

Central Norseman Gold Corporation were responsible for the increased output of the Dundas Goldfield, whilst Moonlight Wiluna G.M's. Ltd. (Timoni Leases), Sons of Gwalia Ltd., and New Coolgardie G.M's. N.L. (Hampton Plains), acted similarly in the North Coolgardie, Mt. Margaret and Coolgardie Goldfields respectively.

The decline in the Murchison tonnage was attributable mainly to Big Bell Mines Ltd., whilst results from other goldfields reflected the normal drift in mining activities.

Though the aggregate State tonnage reported was in close vicinity to that of the previous year, the overall average grade of ore treated dropped slightly from 5.26 to 4.94 dwt. per ton, indicating a desire by the larger producers to preserve the industry rather than exploit their properties and cut short the profitable life of their mines.

It is a matter for regret that the annual gold output is still slightly dropping, but this is inevitable because of the fact that gold is possibly the only commodity today with a fixed price. The industry is subject to all increases in cost of labour and materials, and is, in fact, more greatly affected by present-day rising costs than most other industries because it is generally operating in more isolated districts.

No industry can compete for long with the upward spiral of charges without some compensating rise in the selling price of the commodity it produces, and already we have experienced the closure of some mines. Unless costs are stabilised, or some increased price obtained for gold, more will be seriously affected in the future.

Skilled labour is still scarce on the goldfields and in some instances special efforts are being made by companies to obtain more men from abroad. Considerable progress has been made by Great Western Consolidated N.L. in the development of its Bullfinch project and the erection of a nearby town to accommodate employees. This company deserves congratulation on its efforts.

MINERALS.

The mineral industry is most active, as minerals and metals have risen in price with the increasing demand. The output in 1950 exceeded in value that of 1949 by £41,631, the respective total production values being 1950, £735,878, as against 1949, £694,247. This does not include coal.

The greatest production was of pyrite from Norseman, asbestos, both white and blue, from the North-West, lead from Northampton, Pilbara and the Ashburton, iron-ore from Koolyanobbing and Wundowie, manganese from Horseshoe, near Peak Hill, tin from Greenbushes, and the Pilbara, and gypsum.

Labour has also been scarce in the mineral industry.

Because of the large use of minerals and metals in this mechanical and industrial age, and particularly with the world rearmament programme, there is every possibility of increased activity and production in the future.

COAL.

The coal output during 1950 was 814,351 tons, or 63,757 tons more than in 1949.

Great activity continues at Collie, and increased annual yields are anticipated and are necessary to meet the growing demands for fuel and power.

The Western Collieries open-cut commenced operations towards the end of the year, and is now regularly producing an average of 350 tons per day, which is a very welcome addition to the coal output.

Modern mechanisation is gradually being installed in the various collieries.

The Department's deep drill operated for the greater part of the year, and results were generally satisfactory. Owing to a change in drilling contractors, operations were suspended in October, and are being resumed in January, 1951.

The Department's present anxiety is to see such development in the existing deep mines, and the establishment of additional deep mines as will ensure continuity of supplies for the future. This is essential as the life of the open-cuts is limited.

PART II.—MINERALS.

TABLE 1.—*Quantity and Value of Minerals, other than Gold and Silver, produced and/or exported during Years* 1949 *and* 1950.

Description of Minerals.	1949.		1950.		Increase or Decrease for year, compared with 1949.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	£A.	Tons.	£A.	Tons.	£A.
Abrasive Silica Stone	1·50	9	Nil	Nil	— 1·50	— 9
Alunite (Crude Potash)	1,447·80	43,417	84·45	1,822	— 1,363·35	— 41,595
Antimony Ore and Concentrates	21·68	954	92·19	3,514	+ 70·51	+ 2,560
Arsenic	32·75	982	Nil	Nil	— 32·75	— 982
Asbestos (Chrysotile)	141·27	8,504	210·74	9,157	+ 69·47	+ 653
Asbestos (Crocidolite)	1,155·87	116,828	1,018·41	143,496	— 137·46	+ 26,668
Asbestos (Tremolite)	Nil	Nil	1·00	25	+ 1·00	+ 25
Barytes	Nil	Nil	16·00	56	+ 16·00	+ 56
Bentonite	150·00	450	213·00	599	+ 63·00	+ 149
Beryl Ore	20·45	1,497	16·93	1,431	— 3·52	— 66
Calcite	Nil	Nil	5·00	25	+ 5·00	+ 25
Clays	10,047·00	11,813	6,439·00	4,936	— 3,608·00	— 6,877
Coal	750,954·06	972,245	814,351·53	1,287,749	+ 63,397·47	+ 315,504
Copper Ore, etc.	49·49	630	2·50	183	— 46·99	— 447
Copper Fertiliser	253·98	2,821	969·85	8,867	+ 715·87	+ 6,046
Diatomaceous Earth	540·00	950	Nil	Nil	— 540·00	— 950
Dolomite	49·50	247	319·85	1,268	+ 270·35	+ 1,021
Felspar	1,049·00	3,934	1,421·00	5,329	+ 372·00	+ 1,395
Glass Sand	986·15	1,014	5,132·25	3,566	+ 4,146·10	+ 2,552
Glauconite	203·50	5,286	323·50	8,735	+ 120·00	+ 3,449
Gypsum	25,907·30	18,610	30,835·40	21,942	+ 4,928·10	+ 3,332
Ilmenite Rutile Zircon Sand	71·95	255	84·00	521	+ 12·05	+ 266
Iron Ore	12,524·13	66,296	14,895·23	82,682	+ 2,371·10	+ 16,386
Kaolin	80·00	160	Nil	Nil	— 80·00	— 160
Lead / Silver-Lead / Silver-Lead-Zinc Ore and Concentrates	2,922·13	*152,991	1,865·79	*111,648	— 1,056·34	— 41,343
Magnesite	2,033·76	4,714	1,828·70	3,825	— 205·06	— 889
Manganese Ore	9,420·31	56,289	11,961·64	65,459	+ 2,541·33	+ 9,170
	lb.		lb.		lb.	
Mica	1,253·75	1,343	Nil	Nil	— 1,253·75	— 1,343
	Tons.		Tons.		Tons.	
Ochre Red and Yellow	44·15	366	186·00	1,860	+ 141·85	+ 1,494
Petalite	5·19	52	Nil	Nil	— 5·19	— 52
Pyrites Ore and Concentrates	31,299·00	125,857	35,213·00	163,514	+ 3,914·00	+ 37,657
Talc	181·00	2,375	256·00	2,700	+ 75·00	+ 325
Tantalite Ores and Concentrates	1·16	286	6·69	2,858	+ 5·53	+ 2,572
Tin	34·66	13,079	51·41	25,496	+ 16·75	+ 12,417
	lb.		lb.		lb.	
Tungsten (Scheelite Concentrates)	1,294·00	219	Nil	Nil	— 1,294·00	— 219
	Tons.		Tons.		Tons.	
Vermiculite	161·97	987	120·00	720	— 41·97	— 267
Total	....	1,615,460	....	1,963,983	....	+ 348,523

TABLE 1 (a).—*Quantity and Value of Gold and Silver exported and minted during Years* 1949 *and* 1950.

	Fine ozs.	£A.	Fine ozs.	£A.	Fine ozs.	£A.
Gold	648,425·62	†7,962,808	610,333·41	†9,466,270	— 38,092·21	+ 1,503,462
Silver	204,920·51	51,032	205,103·90	59,644	+ 183·39	+ 8,612
Total	....	8,013,840	....	9,525,914	....	+ 1,512,074
Grand Total	....	9,629,300	....	11,489,897	....	+ 1,860,597

* Excluding Silver value. †Included in the value of Gold shown are the following estimated premiums :— 1949, £A5,208,473 ; 1950, £A6,873,740.

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	17,611,547	5,698,721	32·36
1936	19,564,716	7,130,381	36·45
1937	21,594,942	9,026,313	41·80
1938	24,220,864	10,417,458	43·01
1939	23,244,509	11,969,562	51·49
1940	25,800,562	12,480,721	48·37
1941	24,536,777	12,411,316	50·58
1942	20,681,284	8,476,622	40·99
1943	18,014,340	6,539,295	36·30
1944	19,453,001	(a) 1,282,867	6·59
1945	20,170,624	(b) 205,587	1·02
1946	26,342,125	(b) 211,890	0·80
1947	*42,389,125	(c) 4,162,892*	9.82
1948	57,779,996	(b) 342,646	0·59
1949	58,197,775	(b) 465,124	0·80
1950	78,804,864	(b) 531,245	0·67
Total since 1902	894,892,199	245,844,831	27·47

Exclusive of Arsenic prior to 1935. * Amended figure. † Including Ship's Stores. (a) Approximately 25 per cent. of gold production for year exported. (b) No gold bullion exported. (c) Approximately 50 per cent. of gold production for year exported.

Comparative Statistical Diagrams

showing:

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 1950

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

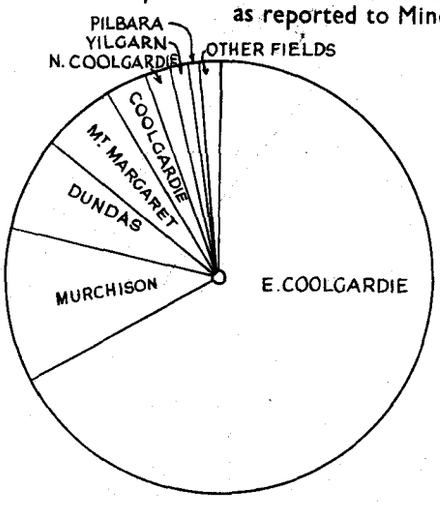


Fig. 2 Gold produced from various Goldfields as given by the Export and Mint Returns

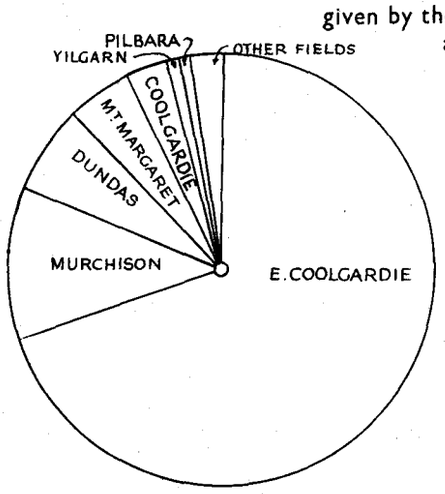


Fig. 3 Value of Gold and other Minerals

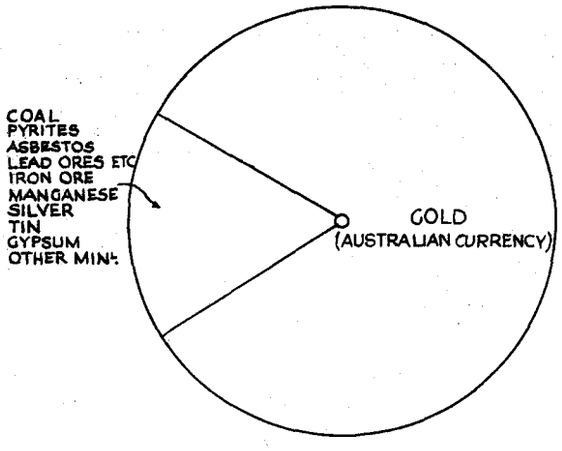


Fig. 4 Value of Minerals other than Gold

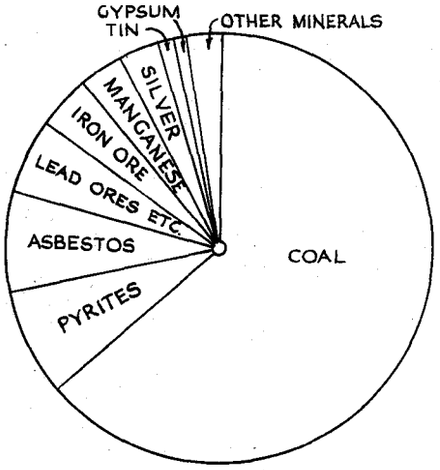


Fig. 5 Areas of land leased for Goldmining on various Goldfields

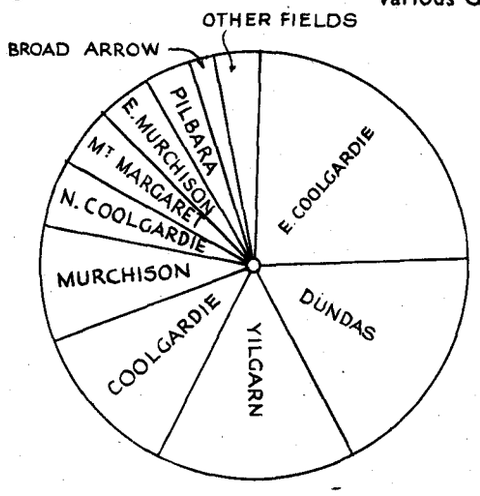


Fig. 6 Output of Gold in the States of Australia and the Dominion of New Zealand

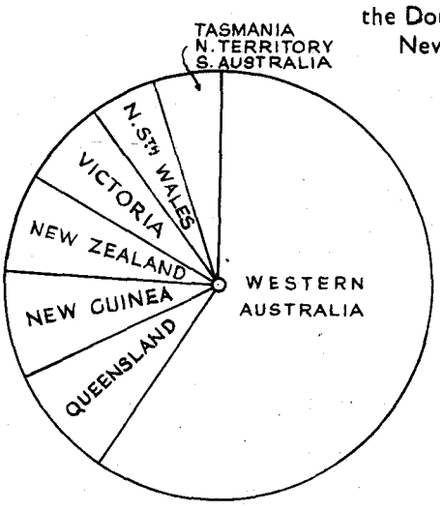


DIAGRAM OF GOLD OUTPUT

Showing Tonnage Treated (as reported to Mines Dept.); the Total Output of Gold Bullion, Concentrates etc., entered for export and received at the Perth Mint, and the Estimated Value thereof, in Australian Currency.

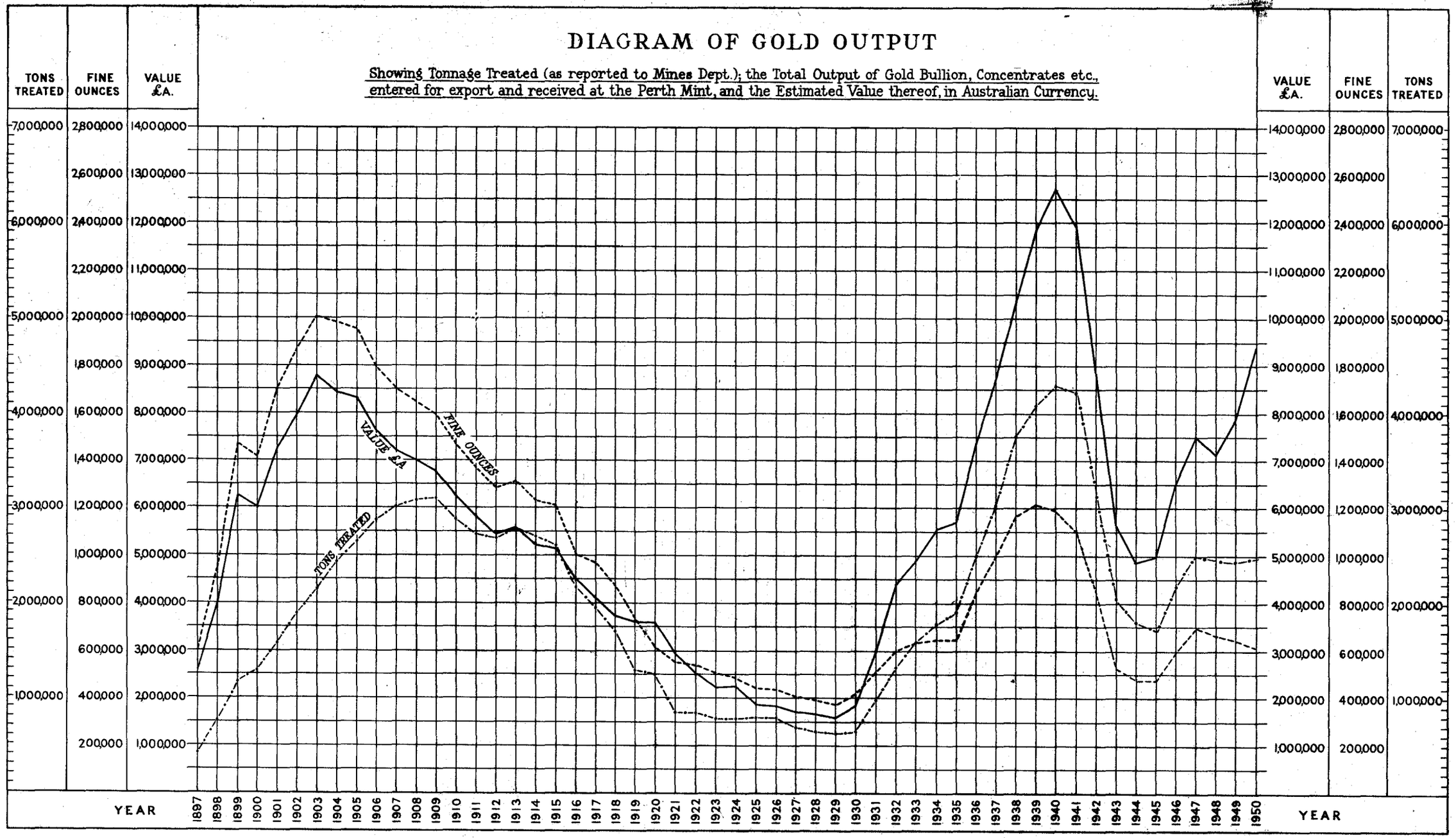


TABLE 3.

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 yield of Gold per ton of ore treated.

Goldfield.	Reported Yield.		Percentage for each Goldfield.		Average Value per ton of Ore Treated. (Gold at £4 4s. 11.45d. per fine oz.).	
	1949.	1950.	1949.	1950.	1949.	1950.
	Fine ozs.	Fine ozs.	%	%	Shillings.	Shillings.
1. Kimberley	269	1,241	·041	·204	(a)	(a)
2. West Kimberley	....	....	....	....	....	....
3. Pilbara	5,712	5,408	·879	·889	88·261	47·194
4. West Pilbara	94	115	·014	·019	14·185	55·196
5. Ashburton	70	54	·011	·009	16·519	30·181
6. Gascoyne	....	....	....	....	....	....
7. Peak Hill	585	565	·090	·093	42·623	27·842
8. East Murchison	6,546	3,067	1·008	·504	(b)	57·940
9. Murchison	81,844	69,058	12·600	11·346	14·216	14·100
10. Yalgoo	793	733	·122	·120	38·040	55·899
11. Mt. Margaret	33,816	32,675	5·206	5·369	31·655	28·436
12. North Coolgardie	7,049	11,889	1·085	1·953	111·996	54·154
13. Broad Arrow	4,287	3,376	·660	·555	72·334	79·846
14. North-East Coolgardie	510	406	·078	·067	32·799	35·485
15. East Coolgardie	437,405	408,169	67·337	67·063	22·601	20·862
16. Coolgardie	13,664	20,913	2·104	3·436	28·134	37·797
17. Yilgarn	8,287	7,220	1·276	1·186	16·703	14·728
18. Dundas	48,600	43,654	7·482	7·172	30·289	23·430
19. Phillips River	30	65	·005	·011	8·276	(a)
20. Outside Proclaimed Goldfield	11	25	·002	·004	(a)	(a)
Totals and Averages	649,572	608,633	100·000	100·000	22·357	20·990

(a) Mainly Dollied and Alluvial. (b) Mainly from treatment of Sands.

The total yield of the State is as shown in Table 1, being the amount of 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 1949 *and* 1950.

Goldfield.	1949.				1950.			
	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	....	....	89·67	26·90	....	....	620·50	155·12
2. West Kimberley	....	....	....	....	....	....	....	....
3. Pilbara	98·18	53·90	102·00	56·00	139·07	66·22	77·26	36·79
4. West Pilbara	140·75	56·30	23·50	9·40	88·50	25·29	57·50	16·43
5. Ashburton	180·00	90·00	35·00	17·50	76·00	38·00	27·00	13·50
6. Gascoyne	....	....	....	....	....	....	....	....
7. Peak Hill	72·87	30·68	36·56	15·39	172·40	61·57	56·50	20·18
8. East Murchison	76·57	24·00	155·86	48·85	132·26	44·09	90·21	30·07
9. Murchison	1,257·36	627·07	210·40	104·93	1,045·39	511·14	173·51	84·84
10. Yalgoo	147·58	70·84	66·08	31·72	79·57	34·81	52·36	22·91
11. Mt. Margaret	381·32	189·47	142·08	70·60	428·16	215·97	143·31	72·29
12. North Coolgardie	46·50	19·80	61·30	25·09	126·02	58·10	80·33	35·92
13. Broad Arrow	62·94	28·77	53·59	23·68	35·92	18·91	33·76	17·40
14. North-East Coolgardie	62·90	30·02	24·29	10·41	54·00	24·92	22·56	9·23
15. East Coolgardie	824·95	448·36	219·47	118·76	808·44	438·56	198·52	107·33
16. Coolgardie	251·59	122·44	83·32	40·55	216·61	122·41	96·37	54·46
17. Yilgarn	366·51	189·86	72·06	37·33	378·62	156·57	65·64	27·14
18. Dundas	474·95	298·93	169·34	106·58	601·84	350·19	165·98	96·58
19. Phillips River	102·67	34·22	10·00	3·33	7·50	2·50	16·25	5·42
20. Outside Proclaimed Goldfields	....	....	....	....	....	....	....	....
Total Averages	697·26	365·02	183·49	95·53	670·14	349·52	165·57	85·97

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, during 1950.

State.	Output of Gold.	Value.*	Percentage of Total.	
			Output of Commonwealth.	Output of Australasia.
	Fine ozs.	£	%	%
1. Western Australia	610,333	2,592,530	64·231	59·444
2. Victoria	67,826	288,106	7·138	6·606
3. New South Wales	51,350	218,121	5·404	5·001
4. Queensland	88,249	374,858	9·287	8·595
5. Tasmania	15,578	66,171	1·639	1·517
6. South Australia	1,141	4,847	·120	·111
7. Papua	585	2,485	·062	·057
8. Northern Territory	35,060	148,925	3·690	3·415
9. Mandated Territory of New Guinea	80,099	340,239	8·429	7·801
10. New Zealand	76,527	325,066	....	7·453
	1,026,748	4,361,348	100·000	100·000

* Exclusive of Premium.

TABLE 6.

Dividends, etc., paid by Western Australian Mining Companies during 1950, *and the Total to date.*

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

Goldfield.	Name of Company.	Dividends Paid.	
		1950.	Grand Total to end of 1950.
		£	£
Pilbara	Various Companies	....	26,513
Peak Hill	do. do.	....	199,305
East Murchison	do. do.	....	1,914,053
Murchison	Hill 50 Gold Mine, N.L.	28,125	268,751
	Various Companies	....	2,764,945
Mt. Margaret	Sons of Gwalia, Ltd.	20,312	2,034,425
	Various Companies	....	958,286
North Coolgardie	do. do.	....	712,551
Broad Arrow	do. do.	....	92,500
North-East Coolgardie	do. do.	....	129,493
East Coolgardie	Boulder Perseverance, Ltd.	56,206	(*a*) 2,607,476
	Golden Horseshoe (New), Ltd.	11,459	(*b*) 4,067,295
	Gold Mines of Kalgoorlie, Ltd.	172,899	721,368
	Great Boulder Proprietary G.M's., Ltd.	156,250	7,278,150
	Lake View & Star, Ltd.	437,500	(*c*) 5,212,000
	North Kalgurli (1912), Ltd.	154,687	1,419,686
	Paringa Mining & Exploration Co., Ltd.	33,805	347,040
	South Kalgurli Consolidated, Ltd.	27,345	1,179,409
	Various Companies	....	11,036,729
Coolgardie	do. do.	....	388,770
Yilgarn	do. do.	....	(*d*) 1,205,556
Dundas	Central Norseman Gold Corporation, N.L.	97,500	877,500
	Various Companies	....	786,162
	Totals	1,196,088	46,227,963

(*a*) Also £45,091 in bonuses and profit-sharing notes in years 1935–36. (*b*) Also £55,000 Capital returned in year 1932 and £42,000 in bonuses and profit-sharing notes in year 1934. (*c*) Also £75,000 in bonuses and profit-sharing notes and £93,750 Capital returned in years 1932–35. (*d*) Also £67,725 Capital returned in 1948 by Edna May (W.A.) Amalgamated, N.L.

TABLE 7.

Quantity and Value of Minerals, other than Gold and Silver, reported to the Mines Department during 1950.

Goldfield, District or Mineral Field.	1950.		Increase or Decrease as compared with 1949.	
	Quantity.	Value.	Quantity.	Value.
	Tons.	£A.	Tons.	£A.
ABRASIVE SILICA STONE—				
Murchison (Mt. Magnet)	....	....	— 1·50	— 9
ALUNITE (Crude Potash)—				
Yilgarn	84·45	1,822	— 1,363·35	— 41,595
ANTIMONY ORE AND CONCENTRATES—				
Pilbara (Nullagine)	92·19	3,514	+ 70·51	+ 2,560
ARSENIC—				
East Murchison (Wiluna)	....	....	— 32·75	— 982
ASBESTOS (Chrysotile)—				
West Pilbara	210·74	9,157	+ 69·47	+ 653
ASBESTOS (Crocidolite)—				
West Pilbara	1,018·41	143,496	— 137·46	+ 26,668
ASBESTOS (Tremolite)—				
West Pilbara	1·00	25	+ 1·00	+ 25
BARYTES—				
Outside Proclaimed Goldfield	16·00	56	+ 16·00	+ 56
BENTONITE—				
Outside Proclaimed Goldfield	213·00	599	+ 63·00	+ 149
BERYL—				
West Kimberley	....	....	— 3·50	— 297
Pilbara (Marble Bar)	4·74	442	+ 4·74	+ 442
Outside Proclaimed Goldfield	12·19	989	— 4·76	— 211
CALCITE—				
Mt. Margaret (Mt. Morgans)	5·00	25	+ 5·00	+ 25
CLAYS—				
Outside Proclaimed Goldfield	6,439·00	4,936	— 3,608·00	— 6,877
COAL—				
Collie	814,351·53	1,185,038	+ 63,397·47	+ 212,793
COPPER ORE, ETC.—				
Ashburton	....	....	— 1·30	— 13
Peak Hill	....	....	— 8·19	— 498
Mt. Margaret (Mt. Morgans)	(c)	107	....	+ 107
Phillips River	2·50	76	— 37·50	— 43
COPPER FERTILISER—				
West Pilbara	821·40	6,160	+ 687·42	+ 4,316
Peak Hill	93·90	2,304	— 19·10	+ 1,375
Yalgoo	....	....	— 7·00	— 48
Mt. Margaret (Mt. Morgans)	9·21	64	+ 9·21	+ 64
Yilgarn	38·37	133	+ 38·37	+ 133
Phillips River	6·97	206	+ 6·97	+ 206
DIATOMACEOUS EARTH—				
Outside Proclaimed Goldfield	....	....	— 540·00	— 950
DOLOMITE—				
Murchison (Mt. Magnet)	319·85	1,268	+ 270·35	+ 1,021
FELSPAR—				
Coolgardie	1,421·00	5,329	+ 372·00	+ 1,395
GLASS SAND—				
Outside Proclaimed Goldfield	5,132·25	3,566	+ 4,146·10	+ 2,552
GLAUCONITE—				
Outside Proclaimed Goldfield	323·50	8,735	+ 120·00	+ 3,449
GYPSUM—				
Yilgarn	20,446·00	14,372	+ 4,484·00	+ 3,191
Dundas	....	....	— 10·00	— 6
Outside Proclaimed Goldfield	10,389·40	7,570	+ 454·10	+ 147
ILMENITE RUTILE ZIRCON SAND—				
Outside Proclaimed Goldfield	84·00	521	+ 12·50	+ 266

TABLE 7—*continued.*

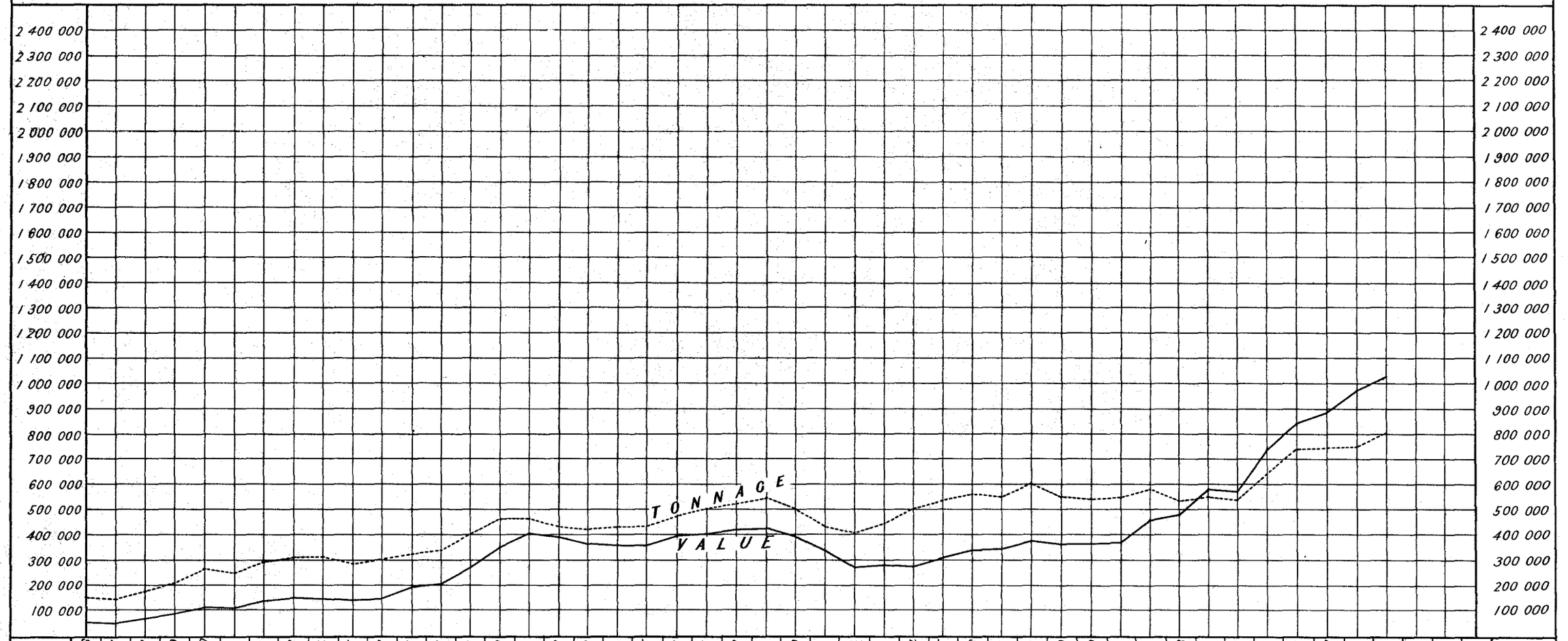
Quantity and Value of Minerals, other than Gold and Silver, reported to the Mines Department during 1950—*continued.*

Goldfield, District or Mineral Field.	1950.		Increase or Decrease as compared with 1949.	
	Quantity.	Value.	Quantity.	Value.
	Tons.	£A.	Tons.	£A.
IRON ORE—				
Yilgarn	(a) 3,069·98	19,922	+ 3,069·98	+ 19,922
Outside Proclaimed Goldfield	(b) 11,825·25	62,760	— 698·88	— 3,536
KAOLIN—				
Outside Proclaimed Goldfield	....	....	— 80·00	— 160
LEAD ORE AND CONCENTRATES—				
Northampton	1,035·05	66,389	— 799·82	— 34,510
*SILVER LEAD ORE AND CONCENTRATES—				
Kimberley	....	....	— 2·46	— 161
Pilbara	445·22	22,891	+ 210·07	+ 11,467
West Pilbara	2·24	82	— 13·08	— 374
Ashburton	345·62	22,353	— 374·30	— 14,996
Peak Hill	....	....	— 5·50	— 295
*SILVER LEAD ZINC ORE AND CONCENTRATES—				
West Kimberley	7·83	216	— 25·55	— 1,267
Northampton	29·83	1,377	— 45·70	— 1,333
MAGNESITE—				
East Coolgardie (Bulong)	....	....	— 26·71	— 74
Coolgardie	40·00	175	+ 19·00	+ 118
Outside Proclaimed Goldfield	1,788·70	3,650	— 197·35	— 933
MANGANESE ORE—				
Peak Hill	11,961·64	65,459	+ 2,541·33	+ 9,170
MICA—	lb.		lb.	
West Kimberley	....	....	— 31·25	— 4
Outside Proclaimed Goldfield	....	....	1,222·50	1,339
OCHRES—	Tons.		Tons.	
West Pilbara	....	....	— 15·60	— 225
Murchison (Cue)	186·00	1,860	+ 175·00	+ 1,794
Yalgoo	....	....	— 7·55	— 38
East Coolgardie	....	....	— 10·00	— 37
PETALITE—				
Coolgardie	....	....	— 5·19	— 52
PYRITES ORE AND CONCENTRATES—				
Dundas	35,213·00	163,514	+ 3,914·00	+ 37,657
TALC—				
East Coolgardie	56·00	210	+ 56·00	+ 210
Outside Proclaimed Goldfield	200·00	2,490	+ 19·00	+ 115
TANTALITE ORES AND CONCENTRATES—				
Pilbara (Marble Bar) (Tantalo/Columbite)	2·29	749	+ 2·29	+ 749
Greenbushes (Tantalo/Columbite)	4·40	2,109	+ 3·24	+ 1,823
TIN—				
Pilbara (Marble Bar)	21·07	8,477	— 10·45	— 3,503
Greenbushes	30·34	17,019	+ 27·20	+ 15,920
TUNGSTEN ORES AND CONCENTRATES—	lb.		lb.	
Coolgardie	....	....	— 1,294·00	— 219
VERMICULITE—	Tons.		Tons.	
East Coolgardie (Bulong)	....	....	— 23·22	— 155
Outside Proclaimed Goldfield	120·00	720	— 18·75	— 112

(a) Koolyanobbing. (b) Wundowie. (c) Copper Matte. * Value of contained Minerals included.

GRAPH OF COAL OUTPUT

Showing Quantities and Values as reported to Mines Dept.



YEAR	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950				YEAR
VALUE £A	57998	55158	75694	90965	113699	111154	135857	153614	148684	137589	147823	191822	204319	270355	350346	407117	381555	368949	363255	363203	394400	407967	420145	426706	394758	336178	270630	289806	278704	318013	312565	340444	376083	362811	364500	389278	461495	469721	583075	572896	730104	840249	880236	972245	1287749				VALUE £A
TONS	149765	142373	175248	214302	262166	249890	295079	313818	319210	286666	301576	326550	337039	401713	462021	468817	438443	420714	421864	437461	474819	501505	528420	544719	501425	432400	415719	458389	500343	537188	565075	553510	604783	557535	539427	556574	581176	531546	558322	543363	642287	730506	732938	750594	814351				TONS

GRAPH SHOWING
ANNUAL TREND IN OUTPUTS

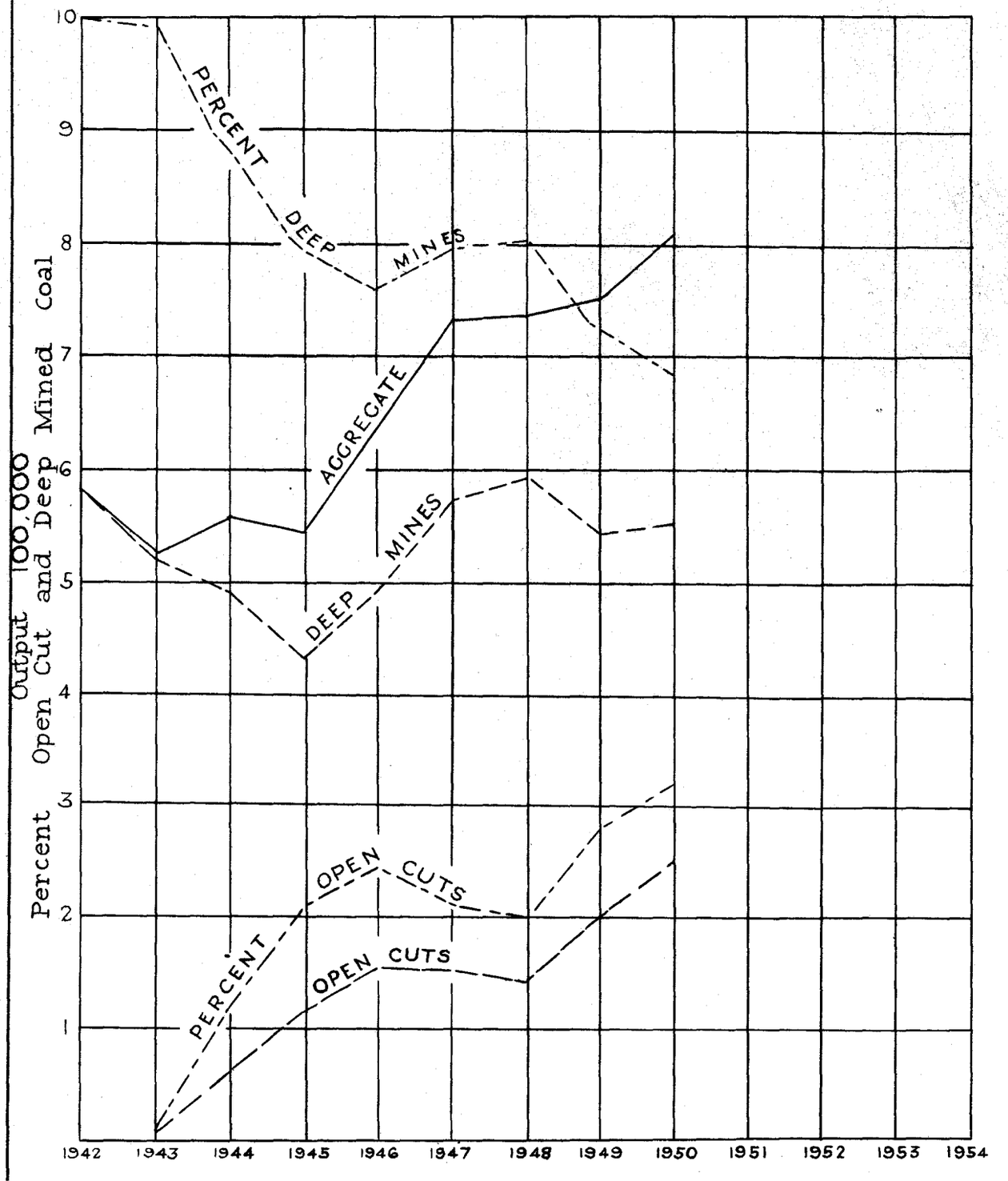


TABLE 8.

Total Coal output from Collie Coalfield during 1949 *and* 1950, *estimated Value thereof, Number of Men employed, and Output per Man as reported Monthly.*

Year.	Total. Output.	Estimated Value.	Men Employed.			Output per Man Employed.		
			Above ground.	Under ground.	Above and under ground.	Above ground.	Under ground.	Above and under ground.
	Tons.	£A.				Tons.	Tons.	Tons.
Deep Mining—								
1949	543,944	711,342	216	716	932	2,518	760	584
1950	556,042	872,952	249	725	974	2,233	767	571
Open-Cut Mining—								
1949	206,650	260,903	112	....	112	1,845	....	1,845
1950	258,310	414,797	125	....	125	2,066	....	2,066
Totals—								
1949	750,594	972,245	328	716	1,044	2,288	1,048	719
1950	814,352	1,287,749	374	725	1,099	2,177	1,123	741

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

TABLE 9.

Total Number and Acreage of Lease, Mineral Claims and Prospecting Areas held for Mining on the 31*st December,* 1949 *and* 1950.

Leases and Other Holdings.	1949.		1950.	
	No.	Acreage.	No.	Acreage.
Gold Mining Leases on Crown Lands	1,380	24,745	**1,542**	**28,140**
Gold Mining Leases on Private Property	10	240	**20**	**480**
Mineral Leases on Crown Lands	210	36,258	**234**	**42,867**
Mineral Claims	263	16,448	**347**	**15,826**
Prospecting Areas	*823	18,690	†591	**16,491**
Totals	2,686	96,381	**2,734**	**103,804**

* Includes 73 Prospecting Areas for Minerals of a total of 5,690 acres.

† Includes 65 Prospecting Areas for Minerals of a total of 7,403 acres.

PART IV.—MEN EMPLOYED.

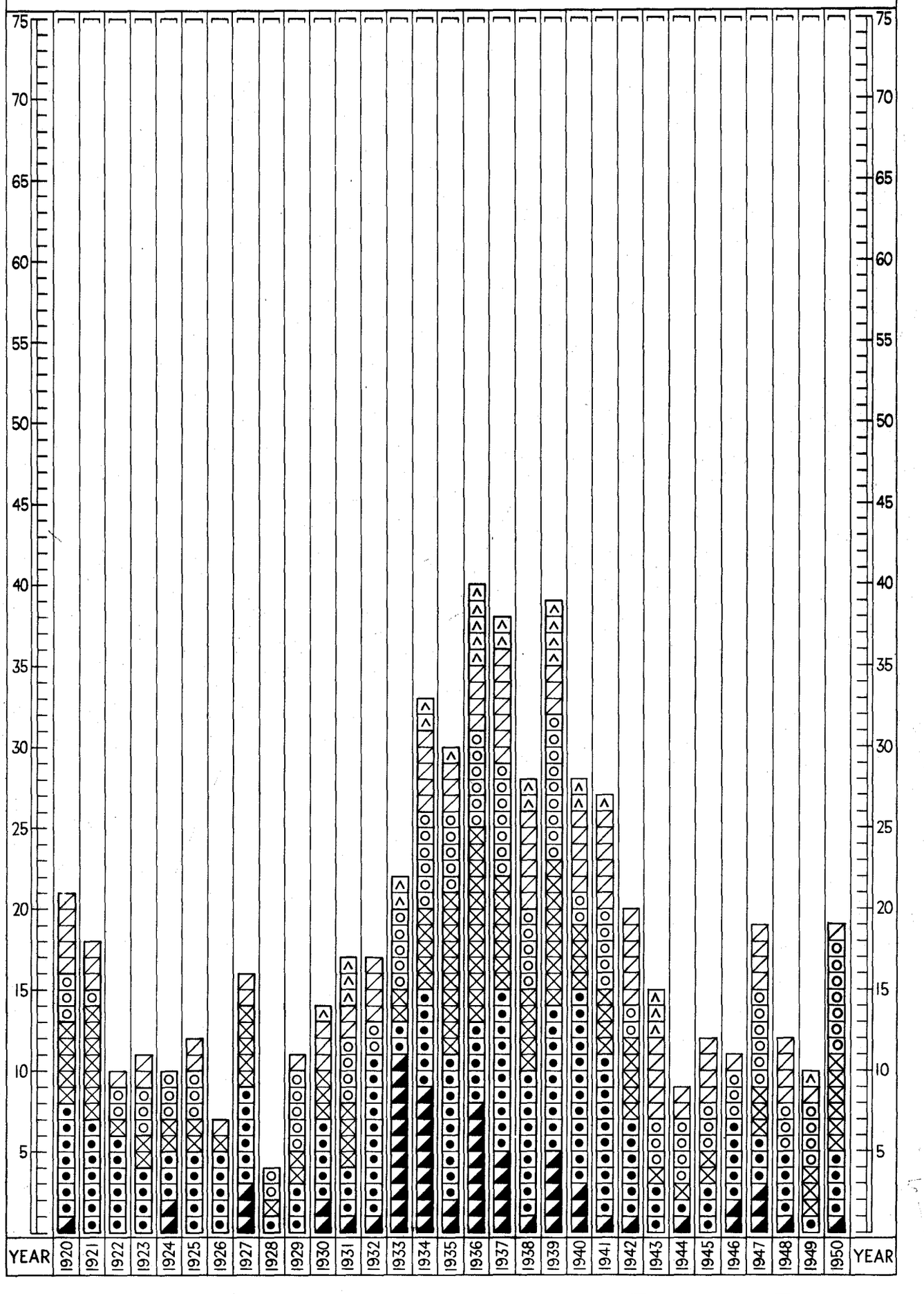
TABLE 10.

Average number of Men reported as engaged in Mining during 1949 *and* 1950.

Goldfield.	District.	Reef or Lode.		Alluvial.		Total.	
		1949.	1950.	1949.	1950.	1949.	1950.
Kimberley		10	8	....	....	10	8
West Kimberley		....	....	....	....	....	....
Pilbara	Marble Bar	52	82	....	....	52	82
	Nullagine	50	65	....	....	50	65
West Pilbara		10	7	....	....	10	7
Ashburton		4	4	....	....	4	4
Gascoyne		....	....	....	....	....	....
Peak Hill		38	28	....	....	38	28
East Murchison	Lawlers	25	21	....	....	25	21
	Wiluna	84	61	....	....	84	61
	Black Range	25	20	....	....	25	20
Murchison	Cue	498	538	....	....	498	538
	Meekatharra	69	67	....	....	69	67
	Day Dawn	44	44	....	....	44	44
	Mt. Magnet	169	165	....	....	169	165
Yalgoo		25	32	....	....	25	32
Mt. Margaret	Mt. Morgans	88	59	....	....	88	59
	Mt. Malcolm	302	313	....	....	302	313
	Mt. Margaret	89	80	....	....	89	80
North Coolgardie	Menzies	117	148	5	3	122	151
	Ularring	56	64	4	4	60	68
	Niagara	26	30	....	....	26	30
	Yerilla	71	79	2	3	73	82
Broad Arrow		175	190	6	4	181	194
North-East Coolgardie	Kanowna	33	27	3	3	36	30
	Kurnalpi	11	12	2	2	13	14
East Coolgardie	East Coolgardie	3,640	3,758	14	10	3,654	3,768
	Bulong	27	32	2	3	29	35
Coolgardie	Coolgardie	296	345	....	....	296	345
	Kunanalling	41	39	....	....	41	39
Yilgarn		222	266	....	....	222	266
Dundas		456	452	....	....	456	452
Phillips River		9	12	....	....	9	12
Outside Proclaimed Goldfields		....	....	....	....	....	....
Total—Gold Mining		6,762	7,048	38	32	6,800	7,080
MINERALS OTHER THAN GOLD.							
Alunite		114	28	....	....	114	28
Asbestos		123	153	....	....	123	153
Bentonite		1	1	....	....	1	1
Beryl		3	1	....	....	3	1
Clays		8	7	....	....	8	7
Coal		1,044	1,099	....	....	1,044	1,099
Copper Ore		3	5	....	....	3	5
Diatomaceous Earth		1	....	....	....	1	....
Dolomite		1	1	....	....	1	1
Felspar		3	6	....	....	3	6
Glass Sand		2	5	....	....	2	5
Glauconite		8	7	....	....	8	7
Gypsum		34	30	....	....	34	30
Iron Ore		30	34	....	....	30	34
Kaolin		1	....	....	....	1	....
Lead/Silver Lead/Zinc		135	119	....	....	135	119
Magnesite		4	3	....	....	4	3
Manganese Ore		13	8	....	....	13	8
Mica		2	....	....	....	2	....
Ochre—Red and Yellow		2	1	....	....	2	1
Pyrites		96	100	....	....	96	100
Talc		2	2	....	....	2	2
Tantalite		2	....	....	....	2	....
Tin		24	21	....	....	24	21
Tungsten Ore (Scheelite)		1	....	....	....	1	....
Vermiculite		2	2	....	....	2	2
Total—Other Minerals		1,659	1,633	....	....	1,659	1,633
GRAND TOTAL		8,421	8,681	38	32	8,459	8,713

DIAGRAM OF ACCIDENTS

Showing the number of Deaths, arranged in Six Classes, in the Mines of Western Australia, from 1920 onwards



PART V.—ACCIDENTS.

TABLE 11.

MEN EMPLOYED IN MINES KILLED AND INJURED IN MINING ACCIDENTS DURING 1949 AND 1950.

A.—According to Locality of Accident.

Goldfield.	Killed.		Injured.		Total Killed and Injured.	
	1949.	1950.	1949.	1950.	1949.	1950.
1. Kimberley	....	....	29	17	29	17
2. West Kimberley	....	....	....	....	....	....
3. Pilbara	....	....	....	1	....	1
4. West Pilbara	....	1	13	8	13	9
5. Ashburton	....	....	....	....	....	....
6. Gascoyne	....	....	....	....	....	....
7. Peak Hill	....	....	1	1	1	1
8. East Murchison	....	....	3	4	3	4
9. Murchison	2	6	46	37	48	43
10. Yalgoo	....	....	....	....	....	....
11. Mount Margaret	1	1	38	21	39	22
12. North Coolgardie	....	....	4	25	4	25
13. North-East Coolgardie	....	....	....	....	....	....
14. Broad Arrow	....	....	....	....	....	....
15. East Coolgardie	4	6	475	433	479	439
16. Coolgardie	1	1	29	30	30	31
17. Yilgarn	....	1	9	14	9	15
18. Dundas	1	....	44	35	45	35
19. Phillips River	....	....	....	....	....	....
Mining Districts—						
Northampton	....	1	....	1	....	2
Greenbushes	....	....	....	....	....	....
Collie	1	1	175	141	176	142
South-West	....	1	6	7	6	8
Totals	10	19	872	775	882	794

From the above Table it will be seen that the number of fatal accidents for the year 1950 was 19 as against 10 in 1949. The number injured showed a decrease of 97. In the report of the State Mining Engineer, published as Division 11. of this Report, these accidents are classified according to their causes.

B.—According to Causes of Accidents.

	1949.		1950.		Comparison with 1949.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1. Explosives	....	7	1	9†	+ 1	+ 2
2. Falls of Ground	1	57	4‡	63§	+ 3	+ 6
3. In Shafts	3	15	6	19	+ 3	+ 4
4. Miscellaneous Underground	4	582	7	522	+ 3	— 60
5. Surface	1	210*	1	159‖	....	— 51
6. Fumes	1	1	....	3	— 1	+ 2
Totals	10	872	19	775	+ 9	— 97

* Includes 6 serious accidents in quarries. † Includes 3 serious accidents in quarries. ‡ Includes 1 fatal accident in quarries. § Includes 3 serious accidents in quarries. ‖ Includes 1 serious accident in quarries.

The Department's chemical laboratories under the direction of Mr. H. Rowledge and through its fuel technology section, continued its programme in regard to coal and greatly as a result of its work Collie coal is now being used in the manufacture of carburetted water-gas, by both the Perth and Fremantle Gas Works. This is a great forward step as it is only a few years ago when sceptics regarded Collie coal as purely a fuel and of no use for gas purposes. In addition much progress has been made in the examination of Collie coal in regard to the particular constituents and uses of each individual seam.

PETROLEUM.

The geological work in the North-West and Kimberley areas was continued during the year, and the results obtained are such as show the desirability of deep drilling being now undertaken.

Such drilling would be a very costly matter and this Department hopes that the company concerned will be able to arrange the necessary finance to permit of same being undertaken.

The Freney Kimberley Oil Company continued operations during the year but owing to many difficulties has not yet been able to complete its borehole.

MINING DEVELOPMENT ACT.

The expenditure incurred in rendering assistance to mine owners and the industry generally under the provisions of this Act totalled £184,915 16s. 11d. and in the previous year £38,454 7s. 1d.

STATE AID TO MINING.

(a) State Batteries.

The number of State batteries existing at the end of the year was 20 with one leased. From the inception to the end of 1950, gold and tin to the value of £14,385,162.62, including gold premium estimated at £4,326,638.05 have been received from the State batteries. 2,878,092.19 tons of auriferous ore have been treated and have produced £9,964,069.61 plus estimated premium of £4,326,638.05 and 81,810.50 tons of tin ore produced tin to the value of £93,883.16 and residues to the value of £572.

During the year 50,871 tons of ore were crushed for 24,049.25 oz. of bullion estimated to contain 20,390.40 fine oz. of gold equal to 8dwt. 0.4gr. per ton. The average value of tailings produced was 4dwt. 3.8gr., making the average head value of 12dwt. 4.2gr. The estimated value of gold produced was 20,390.4oz. by amalgamation and 7,158.70oz. from tailings treatment, a total of 27,549.10oz. valued at £425,831. The working expenditure for all plants for the year was £106,871 4s. 10d. and the revenue was £82,162 16s. 7d., which shows a loss of £24,708 8s. 3d. on the year's operations.

The capital expenditure since inception of the scheme has been £573,711 11s. 6d.: £422,137 2s. 6d. from the General Loan Fund; £109,166 7s. 7d. from Consolidated Revenue; £28,621 13s. 5d. from Assistance to Gold Mining Industry, and £13,786 8s. from Commonwealth Assistance to Metalliferous Mining.

Head Office expenditure including insurance under the Workers' Compensation Act and pay-roll tax was £9,430 8s. 1d. as against £7,063 16s. 4d. for 1949.

The working expenditure from inception to the end of the year exceeds revenue by £221,464 19s. 4d.

(b) Geological Survey of Western Australia.

The principal work of the geological survey for the year 1950 is covered by the following reports published in Division IV of this report:—

Report on Domestic Water Supply "Timoni" Gold Mine, Mt. Ida, North Coolgardie Goldfield.

A Reconnaissance Survey of the Cue and Day Dawn Districts, Murchison Goldfield, W.A.

Report on Progress of a Geological Survey of the Metropolitan Area as at 31/12/50.

Report on the Great Fingall Exploration Venture, 1949-50.

Progress Report on Diamond Drilling, Collie Mineral Field, W.A. Bore No. 1—Site C—Mineral Lease 415, North-East of Shotts.

Progress Report on Diamond Drilling, Collie Mineral Field, W.A. Bore No. 2—Site L—Mineral Lease 152, 2½ miles South of Collie Townsite.

Progress Report on Diamond Drilling, Collie Mineral Field, W.A. Bore No. 3—Site E—Mineral Lease 328, 4 miles East of Collie Townsite.

Shallow Drilling for Open-cut Coal on a portion of Mineral Leases 82, 129 and 130, East Collie Burn, Collie Mineral Field, W.A.

Report on the South-West Iron Reconnaissance.

Summary Report on South-West Limestone Reconnaissance.

Report on Testing a Limestone Deposit Three Miles North-West of Capel, South-West Division.

Report on Survey of the Limestone Deposits of the South-West Division of W.A. Within a radius of 50 miles from Bunbury.

Report on Survey of Limestone Deposits between Harvey River Diversion Channel and Mandurah, South-West Division.

During the year the following publications were issued:—

Annual Progress Report of the Geological Survey of Western Australia for 1947.

Bulletin No. 102: The Greenbushes Mineral Field, by R. A. Hobson, B.Sc. (Hons.) and R. S. Matheson, B.Sc.

Bulletin No. 104: Some Economic Aspects of the Principal Tantalum Bearing Deposits of the Pilbara Goldfield, by H. A. Ellis, B.Sc., A.O.S.M.

Bulletin No. 106: A Geological Reconnaissance of Portion of the Yalgoo, Peak Hill and Gascoyne Goldfields, by W. Johnson, B.Sc. (Hons.).

Atlas of Maps to accompany Bulletin No. 101 (Bull. 101 issued 1947).

The following publications are still in the Press:—

Annual Progress Report of the Geological Survey of Western Australia for 1949.

Bulletin No. 103: Geology of Portion of the Mt. Margaret Goldfield, by R. A. Hobson, B.Sc. (Hons.), and K. R. Miles, D.Sc., with two atlasses of maps.

Mineral Resources of Western Australia Bulletin No. 5: Moulding Sands of Western Australia, by K. R. Miles, D.Sc., and H. A. Stephens, B.Sc.

Bulletin No. 95 (1st Reprint): The Physiography of Western Australia, by J. T. Jutson, B.Sc., LL.B.

Geological Sketch Map of Western Australia, Scale 40 miles = 1in.

The following reports have been compiled and await publication:—

Bulletin No. 107: A Re-survey of the Coolgardie District, W.A., by J. C. McMath, B.Sc. (Hons. Lond.), F.G.S., M.Aust.I.M.M. and N. M. Gray, B.Sc.

Mineral Resources of Western Australia Bulletin No. 6: Silver, Lead and Zinc, by W. Johnson, B.Sc. (Hons.).

Mineral Resources of Western Australia Bulletin No. 7: Vermiculite, Talc and Soapstone, Fuller's Earth, Bentonite and Diatomite, by W. Johnson, B.Sc. (Hons.).

Bulletin No. 108: The Geology of the Irwin River and Eradu Coal Basins, by W. Johnson, B.Sc. (Hons.), J. S. Gleeson, B.Sc., and L. E. De la Hunty, B.Sc.

In course of preparation:—

Bulletin No. 105: The Collie Mineral Field, Part I, by J. H. Lord, B.Sc., F.G.S.

Officers of the Survey have rendered varied types of practical assistance to individuals, syndicates and companies as well as other Government Departments who have been concerned with the exploration of mineral and water resources in all parts of the State.

(c) Assistance Under the Mining Development Act, 1902.

The following statement shows the sums advanced during the year 1950 under this Act:—

	£	s.	d.
(1) Advanced in aid of mining work and equipment of mines with machinery	182,570	9	9
(2) Subsidies on stone crushed for the public being amounts paid to owners of plants crushing at fixed rates	544	8	0
(3) Providing means of transport, equipment and sustenance for prospectors	1,776	19	11
(4) Other assistance	23	19	3
	184,915	16	11

The receipts under this Act exclusive of interest payments amounted to:—

	£	s.	d.
(1) Refund of advances	10,051	10	11
(2) Prospecting refunds	619	14	1
	10,671	5	0

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 6,259 against 6,107 total for the preceding year, showing an increase after all adjustments of 152 boilers.

Of the total 6,259 useful boilers, 3,435 were out of use at the end of the year, 2,831 thorough and 450 working inspections were made and 2,824 certificates were issued.

Permanent condemnations totalled 11 and temporary condemnations 34. Two boilers were transferred beyond the jurisdiction of the Act.

The total number of machinery groups registered was 26,596 against 24,041 for the previous year, showing an increase of 2,555.

Inspections made total 19,543 and 4,816 certificates were granted.

The total miles travelled for the year were 73,421 against 70,760 miles for the previous year, showing increase of 2,661 miles. The average miles travelled per inspection were 3.22 as against 4.07 miles per inspection for the previous year.

Three hundred and fifty-one applications for engine drivers' and boiler attendants' certificates were received and dealt with, and 337 certificates, all classes were granted as follows:—

Winding Competency (including certificates issued under Regulation 40 and Section 60)	26
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)	36
Third Class Competency (including certificates issued under Regulations 40 and 45 and Sections 60 and 63 of the Act)	42
Locomotive Competency (including certificates issued under Regulation 40 and Section 60)	9
Traction Competency (including certificates issued under Regulation 40 and Section 60)	2
Internal Combustion Competency (including certificates issued under Regulation 40 and Section 60)	75
Crane and Hoist Competency (including certificates issued under Regulation 40 and Section 60)	42
Boiler Attendants' Competency (including certificates issued under Regulation 40 and Section 60)	74
Interim	—
Copies	4
Transfers	—
Total	337

The total revenue from all sources during the year was £14,667 18s., as against £11,954 7s. 3d. for the previous year, showing an increase of £3,713 10s. 9d.

The total expenditure for the year was £15,634 10s. 6d., against £16,016 8s. 11d. for the previous year, showing a decrease of £381 18s. 5d.

PART VIII.—THE GOVERNMENT CHEMICAL LABORATORIES.

A considerable increase in the number of samples for analysis and examination was received this year. The total number received by all Divisions was 11,814, as against 8,149 for the past year. This was largely due to the increase in our activities in connection with work for the Metropolitan Water Supply, Sewerage and Drainage Department, the Department of Agriculture, and samples received in the continued search for new water supplies for farmers in the agricultural districts. The volume of work of an advisory nature for other Government departments and general public is increasing from year to year especially in its application to chemical technology and industry.

The bulk of the samples handled by the Food and Drug Division were received from the Police Department, Public Health Department and Metropolitan Water Supply, Sewerage and Drainage Department. The latter in connection with the investigation into the generation of hydrogen sulphide in sewage and the consequent corrosion of cement mains. Food samples were examined for compliance with Food and Drug Regulations and Tender Board for purchase by Government institutions. Chemical examinations were undertaken for the Swan River Reference Committee. The work for the latter was further extended during the year to include the examination of mud samples. Result of this show that chemically the river generally is quite reasonable with the exception of a few focal points. The several points where pollution is occurring are systematically being dealt with. Samples are examined for the Health Department and the Factories Department and advice is given concerning health conditions in factories and works, etc. A number of cheese samples, fruit products, etc., were done for the Department of Agriculture to check the manufactured products and the chemical composition of the natural fruit.

The Agricultural Division handled a large number of samples during the year, mainly for the Department of Agriculture, the chemical control of water supplies and agricultural waters for farmers, market gardeners, graziers and orchardists.

Materials examined for the Department of Agriculture included soils, pastures, cereals and various plant and tree materials and comprised work for the various branches; Plant Nutrition, Plant Pathology, Horticulture, Dairying, Entomology, etc. Much of this work is done to study the growth in plants and occurrence of deficiencies in growth to produce better pasture plants for stock husbandry.

Fertilisers and feeding stuffs were examined for compliance with the Act. The chemical research into the products of Western Australian tobacco continues.

The Mineral Division continues to carry out the valuable work of mineral determinations and evaluation of ores and minerals of economic value and of scientific interest. This work is an important factor in the development of the mineral industry of the State and a number of new mineral localities have been recorded. A new magnetic separator has now been installed and work in connection with the beach and river surveys which has been held up, will be started upon, in an attempt to get sufficient radio active material for analysis. We have tested a number of minerals and ores during the year for radioactivity on the Geiger counter. This Division has carried out, from time to time, analyses of uranium bearing ores for the Commonwealth Mineral Resources Bureau. Advice is given to other Government departments and the general public on the composition of metals and alloys for compliance to specification and susceptibility to corrosion. Building materials have also been examined for the Housing Commission to see if they are up to standard. A number of industrial mineral deposits were examined for evaluation and suitability for use in various industries such as iron smelting and ceramics (including refractories and house bricks).

During the year the Fuel Technology Division has done much valuable work particularly regarding the advances made in its application to industry. The survey or coal working faces in the mines at Collie has been continued and during the year all were examined in detail.

A temporary annex laboratory was established at Collie in October for the purpose of carrying out coal washing and blending tests on a laboratory scale. These are proceeding and results should be available next year.

Progress in the manufacture of carburetted water gas from raw coal was advanced during the year with the help of the Fremantle Gas Company who have given us free access to the works for experimental purposes. This action is much appreciated. Other valuable work has been done on boiler trials with Collie coal. Working facilities provided by the Railways Commission, Colonial Sugar Refining Company and the Swan Brewery is thankfully acknowledged. Work in connection with the use of Collie coal in cupola practice is more or less in the experimental stage. It is hoped to further continue this investigation with the co-operation of the State Engineering Works. Research in to briquetting of Collie coal is receiving regular attention and it is hoped to finalise research of this project in the coming year.

The work of the Industrial Chemistry Division has again been limited by the lack of proper facilities. It is hoped that the erection of the unit process plant will be commenced in the coming year. This will enable the Division to undertake work of benefit to the establishment of chemical industry from our natural raw materials. Much work of a consultative nature has been done for State industries and private industry. The information service is functioning satisfactorily. Investigations undertaken during the year were on insecticides manufacture, sorrel cement, paints, marketable salt and the suitability of limestone in South-West for Portland cement.

PART IX—SCHOOL OF MINES.

(a) Kalgoorlie.

The total number of students enrolled during 1950 was 390, an increase of 30 over the number enrolled in 1949.

The Wiluna School of Mines building was during the year shifted to Kalgoorlie, altered and renovated and re-erected. It now provides accommodation for metallography, metallurgy and mineral dressing.

Extensions to the existing workshop building were carried out and these provided additional accommodation for workshop practice and welding classes.

The Metallurgical Research Laboratory received 39 investigations during the year, and issued 34 reports. These were of a varied nature.

(b) Norseman.

A total of 55 students were enrolled, a decrease of 23 by comparison with 1949. Such decrease was offset by the enrolment of 18 State School children for special classes in sub-junior science subjects, this arrangement being made at the request of the Education Department.

The permanent staff at this School now comprises two senior officers and a cadet. Part-time instructors are recruited mainly from the mining companies operating in Norseman.

PART X—MINERS' PHTHISIS ACT AND MINE WORKERS' RELIEF ACT.

During the year all goldfields were visited by the Mobile Laboratory with the exception of Ashburton, Gascoyne, Kimberley, West Kimberley, Phillips River, Pilbara and West Pilbara, and examinations conducted totalled 5,426 compared with 5,489 for the previous year.

The number of beneficiaries under the Miners' Phthisis Act on 31/12/1950 was 228, being 27 ex miners and 201 widows.

PART XI—CHIEF COAL MINING ENGINEER.

The first report of Mr. G. Morgan, the Chief Coal Mining Engineer is included in this publication. This covers the first completed calendar year of this new Branch, and the information supplied relative to the coal position has been referred to earlier by me under the heading "Coal".

Staff.

Throughout a difficult year, all members of the Staff, Head Office and Outstations, carried out their duties loyally and efficiently, and I am glad to be able to acknowledge publicly their efforts.

In dealing with the various activities I have commented only on the principal items. Divisions II to X of this publication contain the detailed reports of the responsible officers.

(Sgd.) A. H. TELFER,
Under Secretary for Mines.

Department of Mines,
Perth, 31st March, 1951.

Division II

Report of the State Mining Engineer for the Year 1950.

The Under Secretary for Mines,

Sir,

I have the honour to submit for the information of the Hon. the Minister for Mines, my Annual Report on this branch of the Mines Department for the year 1950.

A detailed report on the mining activities in this State for such year (other than Coal Mining), compiled by the Assistant State Mining Engineer and based on reports from the Inspectors of Mines and his own observations in the field, and also on tabulated information supplied by the Departmental Statistical Clerk, is submitted in its entirety as portion of my report.

The growing importance of coal mining has been met departmentally by the appointment of a Chief Coal Mining Engineer and the formation of a branch dealing only with coal mining. This subject, consequently, is not touched on in the present report.

ACCIDENTS.

The year 1950 was unfortunately a particularly bad one so far as fatal accidents were concerned, particularly on gold mines, where 15 fatalities occurred, compared with 9 in the previous year. There were 18 fatal accidents in all, the rate being 2.33 per 1,000 men employed, which compares unfavourably with an average of 1.99 per 1,000 over the past 20 years.

The total serious accidents, on the other hand, showed a definite decrease from 97.35 per 1,000 men employed in 1949 to 84.18 per 1,000 in 1950.

ADMINISTRATION.

The new Mines Regulation Act, 1946, is working smoothly, although certain minor amendments have been necessary.

The Board of Examiners for Mine Managers and Underground Supervisors has had a busy year, and the following certificates were issued—

Mines Managers' Certificates of Service	39
Mine Managers' Certificates of Competency	24
Underground Supervisors' Certificates of Competency	27

VENTILATION.

While ventilation generally has continued to receive constant attention by both Departmental inspectors and mine officials, the greatest interest centres round the introduction of Aluminium Therapy during the year. A large proportion of the change houses on the major mines were equipped for treatment at the end of the year and it is anticipated that all big mines will be so equipped by the end of 1951.

The majority of the mining companies are co-operating to the fullest extent with the Department in attacking all ventilation problems.

GOLD MINING.

The average number of men employed in the gold mining industry throughout the year showed a slight increase—6,800 in 1949 to 7,080 in 1950. The tonnage treated, at 2,463,422 tons was about 5,000 tons lower than in the previous year, while the average grade of ore treated fell from 5.26 dwts. per ton in 1949 to 4.94 dwts. in the year under review, resulting in a drop of 40,941 fine ounces in total gold production. The lower tonnage treated was wholly due to an industrial dispute over contract rates, which resulted in a go-slow policy for a considerable proportion of the year.

The labour force is still inadequate to work the mines to capacity and the rapidly mounting costs, coupled with the static price of gold is causing grave concern in the industry. It is feared that unless the inflationary trend of prices and costs generally can be halted or checked or, alternatively, a higher price obtained for the bullion, some mines working on low grade ore may be forced to cease operations altogether, while others may have to excise large blocks of marginal ore from their reserves, thus appreciably shortening the life of the mines.

On the other hand, it is pleasing to note that the Western Mining subsidiary, New Coolgardie Gold Mines N.L., which commenced operations late in 1949, had a successful year in spite of adverse conditions, while another new company, The Timoni Gold Mine at Mt. Ida, operated by Moonlight Wiluna Gold Mines Ltd., commenced continuous production during the year and treated 11,210 tons for a yield of 5,610 fine ounces.

Great Western Consolidated, another Western Mining Corporation flotation, is actively developing its leases on the Yilgarn Goldfield, installing its central treatment plant at Bullfinch and vigorously pursuing its housing programme. This company should be a large scale producer in the future.

If the unsettled conditions due to rising costs and labour and material shortages can be overcome there is no reason to fear for the future of the gold mining industry in the State.

OTHER MINERALS.

The production of minerals other than gold and coal continued its upward trend during the year. The total value of minerals produced, including that of silver, produced as a by-product from gold, was approximately £736,000, exceeding the value of the previous years' output by £62,000. This increase is partly due to enhanced prices although the output of a number of the minerals showed a substantial increase.

Asbestos production was more or less static as regards tonnage, but the higher prices available for fibre increased the total value from £125,000 in 1949, to £152,000 in 1950. Australian Blue Asbestos Ltd. at Wittenoom Gorge is still largely hampered by the difficulty in obtaining and retaining suitable manpower. The turnover of labour is remarkably high, although the Company spares no trouble or expense in providing all the amenities possible.

Hancock's chrysotile mine at Nunyerri worked throughout the year producing 211 tons of processed fibre, all grades, valued at £9,157.

Production of copper ore for use in fertilisers showed a considerable increase, 972 tons being mined as against 303 tons during the previous year.

Glass sand, glauconite and gypsum showed increased production.

The production of pig iron from the Government owned charcoal iron furnace at Wundowie showed an appreciable increase at 7,726 tons of pig valued at £82,682. The increased output has been made possible by the use of a proportion of high grade ore from Koolyanobbing in place of the lateritic ore from the hills deposits. This industry is making a very valuable contribution to the pig iron needs of the State.

Lead production has continued throughout the year, and though neither tonnage nor value reached the 1949 figures the position of the industry appears more secure than previously. The high light of the year, so far as lead is concerned, is probably the interest taken in its production by big interests

represented by Anglo Westralian Ltd., who have acquired the Protheroe mine in the Northampton area and have under option the promising mine at Ragged Hills. Comparatively large and continuous production is anticipated from these mines.

Manganese ore production from the Peak Hill Goldfield was approximately 25 per cent. higher than in the previous year, the unit value remaining practically constant.

There was a slight rise in the amount of pyrite raised by Norseman Gold Mines N.L. from 31,000 to 35,000 tons. Owing to a unit rise in the price the value was £163,000 compared with £126,000 during the previous year. Plans are in hand to increase the output from this fine ore body to meet the quickly rising demand.

It is interesting to note the production of an appreciable quantity of tantalo-columbite after a lapse of some years. No columbite has previously been sold as such in this State and it has always been regarded as a diluent of tantalite. The concentrates are now sold, however, on the basis of mixed oxides of tantalum and niobium. This should result in making available for the market a considerable tonnage of columbite the tantalum content of which has hitherto been too small to make it marketable as tantalite.

While the production of tin in this State is not as great as it should be, the unprecendented and almost fantastic prices recently paid for the metal have had the result of increasing the output fairly considerably. It is felt, however, that a total production of 51 tons of concentrate for a year should be considerably exceeded in this State.

It was fully anticipated that the mining of iron ore from Cockatoo Island would have commenced during 1950, but such was not the case. It is understood that the ships which were to have loaded the ore were diverted to other purposes.

The general interest in economic and strategic minerals in this State is gradually increasing and will, I think, continue to increase in the future.

General.

In the normal course of events, as I am due to retire early next year, this will be the final annual report with which I am associated.

Under these circumstances I should like to take this opportunity to express my appreciation of the unvarying courtesy and assistance I have had from every member of the staff during my 17 years association with the Mines Department.

The Departmental policy of assisting the mining industry in every way possible is one with which I am proud to have been associated and I am sure that it is reflected in the universal goodwill of the mining public towards the Department.

My relations with yourself and the Heads of Branches have always been of the most cordial and I particularly wish to thank the Assistant State Mining Engineer, all Inspectors of Mines and other officers attached to this Branch for their loyal and valuable co-operation during my term of office.

(Sgd.) JOHN S. FOXALL,
State Mining Engineer.

26th July, 1951.

ANNUAL REPORT FOR 1950.

State Mining Engineer.

Mining activities in the State during the year 1950 are detailed in this report, which is based on information supplied by the Statistician and by Inspectors of Mines.

ACCIDENTS.

Fatal and serious accidents in metal mines and quarries reported to the Department are shown below. Corresponding figures for 1949 are shown in brackets.

There were 18 (9) fatal and 634 (697) serious accidents.

In gold mines there were 15 (9) fatal and 596 (639) serious accidents. The number of men employed in such mines was 7,080 (6,800). The accident rate per 1,000 men employed was thus 2.54 (1.32) for fatal and 84.188 (97.35) for serious accidents.

Of the three remaining fatal accidents, one occurred in a lead mine, one in an asbestos mine and one in a quarry.

A classification of serious accidents showing the nature of the injuries is given in Table A.

Table B shows the fatal, serious and minor accidents reported and the number of men employed classified according to the mineral mined.

Accidents classified according to causes for the various districts are shown in Table C.

WINDING MACHINERY ACCIDENTS.

There were 13 accidents involving winding machinery. They are briefly described as follows:—

Overwinds.—(2) In both cases the overwind was due to the driver's error. No serious damage resulted.

Skip Derailments.—(7) These all occurred on the Sons of Gwalia, and are mainly attributed to defective track.

Cages Hung Up.—(3) Two of these accidents occurred in the Victoria Shaft on the Kalgoorlie Enterprise mine. In one case a truck in the cage became loose and caught in the timber and in the other case a stone lodged in the shaft and caught the descending cage.

The remaining accidents occured in the Federal Shaft of the Paringa Mine where the safety grippers engaged accidentally.

Miscellaneous.—(1) A fatal accident on the Boulder Perseverance Mine is described under Fatal Accidents.

PROSECUTIONS.

Six persons were prosecuted under the provisions of the Mines Regulation Act.

Two miners were fined for blasting at times other than those laid down in the Act.

Two miners were cautioned and ordered to pay costs for not installing an air hose to blow to the bottom of a winze after firing.

The manager of a mine and the miner involved were fined for breaches of the Regulations arising from the irregular use of a hoist.

SUNDAY LABOUR.

Permission for Sunday labour was granted on five occasions. Work was carried out on 26 Sundays for a total of 294 man-shifts.

EXEMPTIONS.

In accordance with the provisions of Section 46 of the Mines Regulation Act, 16 permits exempting the holders from the provisions of subsection 1 (b) of the same section were issued. The number of permits issued in 1949 was 58.

ADMINISTRATION.

Mine Workers' Relief Act.

Regulations 18B, 41 and 46 have been amended in conformity with changes in the Mines Regulation Act and Workers' Compensation Act and the necessary alterations have been made to the related forms.

Mines Regulation Act.

The form of report on the medical examination of winding drivers has been amended.

Regulation 255 which required that applicants for medical certificates should be able to speak the English language has been deleted.

Districts assigned to District Inspectors of Mines and to Workmen's Inspectors of Mines have been adjusted.

TABLE A.

SERIOUS ACCIDENTS FOR 1950.

Class of Accident.	Kimberley and West Kimberley.	East Coolgardie.	Peak Hill.	Yilgarn.	Coolgardie.	Dundas.	Broad Arrow.	Mt. Margaret.	North Coolgardie.	East Murchison.	Murchison.	Pilbara.	West Pilbara.	South-West.	Northampton.	TOTAL.
Major Injuries—Exclusive of Fatal—																
Fractures :																
Head	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Shoulder	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Arm	....	....	1	....	....	....	....	....	....	....	1	....	....	1	....	3
Hand	....	7	....	....	1	1	....	....	1	....	....	....	....	....	....	10
Spine	....	1	....	....	....	....	....	1	....	....	....	....	....	....	....	2
Rib	1	3	....	....	2	1	....	1	....	....	4	....	....	....	....	12
Pelvis	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Thigh	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Leg	....	4	....	....	3	1	....	....	....	....	....	1	....	....	....	9
Ankle	....	2	....	1	....	....	....	....	....	....	....	....	....	....	....	3
Foot	1	4	....	....	....	....	....	....	1	....	1	....	....	....	....	7
Amputations :																
Arm	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Hand	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1
Finger	1	3	....	....	2	....	....	1	....	....	....	....	....	1	....	8
Leg	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Foot	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Toes	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Loss of Eye	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Serious Internal	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Hernia	....	3	....	....	....	1	....	....	1	....	....	....	....	....	....	5
Dislocations	....	5	....	....	....	....	....	....	....	....	....	....	1	....	....	6
Other Major	1	....	....	....	....	1	....	....	....	....	....	....	....	....	....	2
Total Major	5	33	1	1	8	5	....	3	3	....	6	1	1	3	....	70
Minor Injuries—																
Fractures :																
Finger	....	15	....	2	4	....	....	3	....	....	3	....	1	1	....	29
Toe	....	11	....	....	1	....	....	2	....	1	2	....	....	....	....	17
Head	....	2	....	....	....	....	....	1	....	....	....	....	....	....	....	3
Eyes	1	14	....	....	....	5	....	....	....	....	....	....	....	....	....	20
Shoulder	....	10	....	2	....	1	....	....	....	1	....	....	....	....	....	14
Arm	....	21	....	1	....	....	....	2	2	2	2	....	....	....	....	30
Hand	3	114	....	3	6	5	....	4	6	....	5	....	2	....	....	148
Back	1	73	....	2	3	5	....	....	3	....	5	....	3	....	1	96
Rib	....	14	....	....	1	....	....	1	....	....	....	....	....	....	....	16
Leg	2	59	....	2	....	8	....	2	1	....	10	....	1	1	....	86
Foot	3	44	....	....	6	5	....	2	5	....	2	....	....	....	....	67
Other Minor	2	23	....	1	1	1	....	1	5	....	2	....	....	2	....	38
Total Minor	12	400	....	13	22	30	....	18	22	4	31	....	7	4	1	564
Grand Total	17	433	1	14	30	35	....	21	25	4	37	1	8	7	1	634

TABLE B.

Minerals Mined.	Men Employed.	Accidents.		
		Fatal.	Serious.	Minor.
Copper	5	....	....	....
Gold	7,080	15	596	2,006
Iron	154	....	17	37
Lead, Silver, Zinc	119	1	1	....
Tin, Wolfram, Tantalite	21	....	....	....
Asbestos	153	1	9	54
Other Minerals	202	....	4	29
Quarries	Not available	1	7	9
Totals	7,734	18	634	2,135

TABLE C.

Fatal and Serious Accidents Showing the Causes and Districts in which they occurred.

District	Explosives.		Falls of Ground.		In Shafts.		Fumes.		Miscellaneous Underground.		Surface.		Total.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1. East Coolgardie	1	3	2	29	1	5	....	3	2	323	....	70	6	433
2. Mt. Margaret	....	....	....	4	1	....	....	....	....	14	....	3	1	21
3. Coolgardie	....	....	....	4	1	....	....	....	....	18	....	8	1	30
4. North-East Coolgardie	....	....	....	....	....	....	....	....	....	....	....	....	....	....
5. North Coolgardie	....	....	....	4	....	3	....	....	....	10	....	8	....	25
6. Broad Arrow	....	....	....	....	....	....	....	....	....	....	....	....	....	....
7. Dundas	....	....	....	2	....	1	....	....	....	23	....	9	....	35
8. Yilgarn	....	....	1	....	....	5	....	....	....	4	....	5	1	14
9. Murchison	....	2	....	2	3	5	....	....	3	14	....	14	6	37
10. East Murchison	....	....	....	....	....	....	....	....	....	....	....	4	....	4
11. Peak Hill	....	1	....	....	....	....	....	....	....	....	....	....	....	1
12. Yalgoo	....	....	....	....	....	....	....	....	....	....	....	....	....	....
13. Northampton	....	....	....	....	....	....	....	....	....	1	1	....	1	1
14. Greenbushes	....	....	....	....	....	....	....	....	....	....	....	....	....	....
15. South-West	....	3	1	3	....	....	....	....	....	....	....	1	1	7
16. Phillips River	....	....	....	....	....	....	....	....	....	....	....	....	....	....
17. Pilbara	....	....	....	1	....	....	....	....	....	....	....	....	....	1
18. West Pilbara	....	....	....	3	....	....	....	....	1	4	....	1	1	8
19. Ashburton	....	....	....	....	....	....	....	....	....	....	....	....	....	....
20. Gascoyne	....	....	....	....	....	....	....	....	....	....	....	....	....	....
21. Kimberley and West Kimberley	....	....	....	....	....	....	....	....	....	....	....	17	....	17
Total for 1950	1	9	4	52	6	19	....	3	6	411	1	140	18	634
Total for 1949	....	7	1	57	3	15	1	1	4	582	1	210	10	872

FATAL ACCIDENTS.

A brief description of fatal accidents reported during the year is given below—

Name and Occupation.	Date.	Mine.	Details and Remarks.
Tomas, Joze (Miner); Pazanin, Bozo (Miner)	13–1–50	Big Bell	These men were working on the 433 foot level of the Big Bell Mine when a fall occurred in a nearby stope. It is estimated that from 30,000 to 35,000 tons of rock fell and both men were killed by the resultant blast of air.
Oxley, Ernest Albert (Miner)	6–2–50	Great Boulder	A fall of ground occurred when preparations to rig a bar were being made in a stope. The stope had recently been filled with slime and the usual precautions for safety had been taken.
Bell, Leslie (Miner)	14–2–50	South Kalgurli	An explosion occured while a hole was being charged. The tamping stick was blown to pieces. Because of this and the appearance of holes which had already been loaded it is thought that too much force was employed during the loading operation.
McKenzie, John Alexander (Miner)	6–3–50	Big Bell	An electric shock from a portable electric lamp which occurred when he attempted to move the lamp caused this man's death. Another man who went to his assistance also received a shock which fortunately was not fatal. This type of equipment is no longer used underground.
Smith, Henry George Frank (Timberman); Martin, Sydney Alfred (Timberman)	10–3–50	Big Bell	These men were doing a repair job in the shaft and were struck by the descending counterweight. The cage had only travelled to the 800 level until the previous day, when it was adjusted to travel to the 1050 and these men gave the driver his marks. Apparently they overlooked the fact that the counterweight would travel past them.
Fitzgerald, Roy Francis (Miner)	13–3–50	Australian Blue Asbestos	This man was electrocuted by a stray current caused by a damaged cable.
Di Giacomo, Antonio (Miner)	27–3–50	Mountain View	This man descended a winze below a kibble which was being loaded with steel. The kibble got away and struck him. Subsequent tests revealed no defect in the hoist. The driver of the hoist and the manager of the mine were prosecuted for breaches of safety regulations.
Kemp, Francis Henry (Miner)	16–6–50	Blackett's	A kibble in which dirt was being hauled from a shaft in process of sinking escaped owing to the gears coming out of mesh. The falling load could not be controlled by the brake and it fell on the man in the bottom of the shaft.

Name and Occupation.	Date.	Mine.	Details and Remarks.
Wainwright, Keith Boswell (Tram Guard)	10–7–50	Gold Mines of Kalgoorlie	This man was crushed between an ore truck and the wall of the drive during shunting operations. The drive has been widened to prevent any possibility of a similar accident.
Yovich, Luka (Miner)	4–9–50	Sons of Gwalia	While getting out of the skip this man slipped off a bearer and fell down the shaft.
Etherington, Joseph Foster (Shift Boss)	5–9–50	Lake View and Star	There were no witnesses to the accident but circumstantial evidence makes it clear that Etherington slipped into an ore pass while trying to free rocks held up in the upper section. His body was recovered from the lower section.
Selkirk, Robert Edwin (Platman)	13–9–50	Boulder Perseverance	The winder driver was given the signal to lower the cage which was at the brace so that the top deck would come to the surface level. He had occasion to leave his stand and on returning moved the cage in conformity with the signal. The platman who was standing near the cage was apparently caught unawares.
Davies Frederick Joseph (Fitter)	18–9–50	Baddera	Davis went behind a live switchboard to examine it with the object of designing some alterations. He inadvertently touched a live terminal.
Drakulich, Dane (Miner)	6–10–50	North Kalgurli	While barring down loose rock in a stope Drakulich lost his balance and moved into the path of a falling stone.
Maifri, Angelo (Miner)	4–12–50	Firelight	This man went into an old shrink stope to move some ore and the footwall of the stope collapsed.
Dawson, James (Quarryman)	15–12–50	White Rock Quarries	A piece of rock falling from the quarry face struck this man and knocked him off the bench where he was working. He fell to the quarry floor about 70 feet below.

VENTILATION.

A report by Inspector Lloyd on ventilation is quoted below. In this report reference is made to the installation of aluminium treatment for the prevention of silicosis.

The international conference of experts on pneumoconiosis was held in Sydney in February and March of 1950 and was attended by the writer. This conference found that there was "no conclusive evidence before the conference that the inhalation of aluminium in any form prevents the development of silicosis in man." The application of aluminium powder in change rooms is continuing in other parts of the world and encouraging reports have been received from Canada.

In addition to the steady progress which has been maintained in matters of ventilation as a direct result of the interest and enthusiasm shown by the ventilation officers attached to all the larger mines, it is very gratifying to report that the long awaited treatment for combating the evils of silicosis has at last become a reality.

In July the first consignment of aluminium therapy equipment arrived from the McIntyre Research Foundation of Canada and steps were immediately taken to issue same to those mines which had completed the necessary alterations to existing change houses or had constructed new ones. Although treatment is not compulsory, there have been very few objectors and in time these men will realise the benefits which are obtainable by undergoing treatment.

At the end of the year 1,450 men were receiving treatment.

On the 10 mines which have commenced treatment there are 21 change houses and a further seven will be completed early next year.

In connection with dust sampling, additional equipment was provided by the Department by purchase of two Watson Victor Circular Konimeters and these instruments are regarded by the officers concerned as a great improvement on the old Kotze Konimeter, in that the cumbersome method of transporting the microscope to outback centres is dispensed with, also the tedious work of slide preparation.

ACCIDENTS.

Accidents due to fumes as reported to this office during the year were as follows:—

	Minor	Serious.
East Coolgardie	26	3
Other districts	—	—
	26	3

CONCLUSION.

Both Assistant Inspectors have visited outback mines and throughout the year have been fully occupied in attending to matters concerning dust and ventilation, also investigations into fuming accidents.

Attached is a tabulation of dust counts by both inspectors.

TABULATION OF DUST COUNTS.

Month.	Development.		Stoping.		Level.		Surface.		Places showing 1000+p.p.c.c.			
	No. of Samples.	Average Count.	No. of Samples.	Average Count.	No. of Samples.	Average Count.	No. of Samples.	Average Count.	Development.	Stope.	Level.	Surface.
January	7	205	23	314	3	423	....	....	....	....	1	....
February	5	179	11	150	....	....	....	....	....	....	....	....
March	5	190	8	116	....	....	....	....	....	1	....	....
April	6	230	13	117	2	305	....	....	1	....	1	....
May	11	245	28	235	4	318	....	....	....	1	1	....
June	4	162	14	174	3	50	....	....	....	....	....	....
July	9	95	14	110	1	80	....	....	....	....	....	....
August	46	196	56	147	11	176	....	....	1	....	....	....
September	57	241	85	185	2	605	....	....	....	1	1	....
October	37	255	47	274	3	167	....	....	1	....	....	....
November....	39	139	94	162	4	340	11	298	....	....	....	3
December....	18	160	37	160	1	240	....	....	....	....	....	....
Totals	244	205	215	185	34	253	11	298	3	3	4	3

GOLD MINING.

The ore produced during the year amounted to 2,463,422 tons and the gold yield was 608,633 fine ounces. The corresponding figures in the previous year were 2,468,297 tons of ore for 649,572 fine ounces of gold.

The tonnage treated is thus almost the same as for the previous year but the gold yield has fallen by about seven per cent.

The average grade has declined from 5.26 dwts. per ton to 4.94 dwts. per ton.

In view of the increased price of gold in Australian currency as from September, 1949, this is a somewhat disappointing year.

The decline in production may be attributed to a shortage of labour on the goldfields. The introduction of migrant labour has been moderately successful but the labour force is still below requirements.

The total number of men employed in the industry based on averages of the monthly returns was 7,080 as compared with 6,800 in the previous year so that the output per man, on the average, is lower.

This is largely due to an industrial dispute over contract rates which resulted in a decreased output for a considerable part of the year.

Rising costs due to increases in wage rates and commodity prices have had an adverse effect but the reduction in grade indicates that there has been a slightly better margin of profit so far as this year is concerned. The prospect for the future with further increases anticipated is not bright.

Some uneasiness regarding the price of gold doubtless contributes to the uncertainty of the present outlook. There are persistent attempts in certain quarters to obtain a free market for gold, and some speculation based on this possibility seems inevitable.

The calculated value of the gold produced is £9,428,739 as compared with £7,977,200 for the previous year.

It is interesting to note that while the output per man both in tons of ore and ounces of gold is lower than for the previous year, the value of the gold produced is higher.

In 1949 the output per man was 362.98 tons of ore and 95.53 ounces of gold or £1,173. This year the output per man was 347.94 tons of ore, 85.96 ounces of gold or £1,332.

Statistics relating to gold mining are tabulated as follows:—

Table D—Gold production statistics.

Table E—Classification of gold output by Goldfields and Districts.

Table F—Classification of gold output, 1946-1950.

Table G—Mines producing 5,000 ounces and over for the past five years.

Table H—Development footages.

Timoni has been added to the list of mines producing 5,000 ounces or more and this brings the total number to 18 mines.

The tonnage of ore treated at State Batteries was somewhat higher, 50,871 tons as compared with 41,171 tons but the gold recovered by amalgamation was lower, 20,390 fine ounces as compared with 22,555 fine ounces. The average grade dropped from 10.96 dwts. per ton to 8.02 dwts. per ton. The gold recovered by cyanidation increased from 5,827 fine ounces to 7,159 fine ounces.

The gold obtained from the larger treatment plants totalled 22,333 fine ounces as compared with 22,389 fine ounces in the previous year.

Most of the larger mines showed a lower return per ton, the most striking being Central Norseman which declined from 7.05 dwts. to 5.45 dwts. per ton.

TABLE D.

Gold Production Statistics.

Year.	Tons Treated. (2,240 lb.)	Total Gold Yield.	Estimated Value of Yield.	Value of Yield per ton.	Number of Men Employed.	Average Value of Gold per oz.	Average Yield per ton of ore.
	tons.	fine ozs.	£A.	shillings A.		shillings A.	dwts.
1929 ...	628,400	372,064	1,580,426	50·30	4,108	84·96	11·84
1930 ...	645,344	419,767	1,874,484	58·09	4,284	89·33	13·01
1931 ...	982,163	518,045	3,042,019	61·94	5,961	117·44	10·55
1932 ...	1,327,021	599,421	4,358,989	65·70	8,695	145·44	9·03
1933 ...	1,588,979	636,928	4,884,112	61·48	9,900	153·36	8·01
1934 ...	1,772,931	639,871	5,461,004	61·60	12,523	170·69	7·22
1935 ...	1,909,832	646,150	5,676,679	59·45	14,708	175·71	6·77
1936 ...	2,492,034	852,422	7,427,687	59·61	15,698	174·27	6·84
1937 ...	3,039,608	1,007,289	8,797,662	57·99	16,174	174·68	6·64
1938 ...	3,759,720	1,172,950	10,409,928	53·38	15,374	177·50	6·24
1939 ...	4,095,257	1,188,286	11,594,221	56·62	15,216	195·14	5·80
1940 ...	4,291,709	1,154,843	12,306,816	57·35	14,594	213·15	5·38
1941 ...	4,210,774	1,105,477	11,811,989	56·10	13,105	213·70	5·25
1942 ...	3,225,704	845,772	8,840,642	54·81	8,123	209·04	5·24
1943 ...	2,051,011	531,747	5,556,756	54·185	5,079	209·00	5·185
1944 ...	1,777,128	472,588	5,966,451	55·89	4,614	210·18	5·32
1945 ...	1,736,952	469,906	5,025,039	57·86	4,818	213·87	5·41
1946 ...	2,194,477	618,607	6,657,762	60·70	6,961	215·25	5·64
1947 ...	2,507,306	701,752	7,552,611	60·25	7,649	215·25	5·59
1948	2,447,545	662,714	7,132,748	58.28	7,178	215.25	5.42
1949	2,468,297	649,572	7,977,200	64.64	6,800	245.62	5.26
1950	2,463,423	608,633	9,428,745	76·55	7,080	309·83	4·94

TABLE E.

Classification of Gold Output for 1950 by Goldfields and Districts.

Goldfield and District.	Unclassified, Sundry Claims, Alluvial, etc. (fine ozs.)	Under 100 ozs.		100–500 ozs.		500–1,000 ozs.		1,000–2,000 ozs.		2,000–3,000 ozs.		3,000–4,000 ozs.		4,000–5,000 ozs.	
		No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).
Kimberley Goldfield	207	....	....	....	....	....	....	1	1,034	....	....	....	....	....	....
Ashburton Goldfield	10	1	44	....	....	....	....	....	....	....	....	....	....	....	....
Pilbara Goldfield—															
Marble Bar	210	10	281	3	541	1	771	....	....	1	2,093	....	....	....	....
Nullagine	237	7	116	2	503	1	656	....	....	....	....	....	....	....	....
West Pilbara Goldfield	82	2	33	....	....	....	....	....	....	....	....	....	....	....	....
Peak Hill Goldfield	4	8	333	1	227	....	....	....	....	....	....	....	....	....	....
East Murchison Goldfield—															
Lawlers	25	4	123	1	198	....	....	....	....	....	....	....	....	....	....
Wiluna	176	7	276	4	1,056	1	503	....	....	....	....	....	....	....	....
Black Range	14	3	37	2	659	....	....	....	....	....	....	....	....	....	....
Murchison Goldfield—															
Cue	600	6	349	3	582	1	661	....	....	....	....	....	....	....	....
Meekatharra	266	10	305	5	1,096	1	890	....	....	1	2,345	....	....	....	....
Day Dawn	115	4	72	....	....	....	....	....	....	1	2,332	....	....	....	....
Mt. Magnet	159	7	178	....	....	....	....	....	....	....	....	....	....	....	....
Yalgoo Goldfield	16	8	155	3	562	....	....	....	....	....	....	....	....	....	....
Mt. Margaret Goldfield—															
Mt. Morgans	99	3	38	4	1,406	....	....	....	....	....	....	....	....	....	....
Mt. Malcolm	65	5	110	3	494	....	....	....	....	....	....	....	....	....	....
Mt. Margaret	112	5	183	3	1,154	2	1,789	1	1,667	....	....	....	....	....	....
North Coolgardie Goldfield—															
Menzies	157	7	137	5	639	....	....	....	....	....	....	....	....	....	....
Ularring	92	9	390	5	1,416	1	852	....	....	....	....	....	....	....	....
Niagara	24	1	55	1	115	1	505	....	....	....	....	....	....	....	....
Yerilla	133	2	15	1	203	....	....	1	1,546	....	....	....	....	....	....
Broad Arrow Goldfield	625	11	293	3	729	3	1,729	....	....	....	....	....	....	....	....
North-East Coolgardie Goldfield—															
Kanowna	112	3	103	1	171	....	....	....	....	....	....	....	....	....	....
Kurnalpi	20	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East Coolgardie Goldfield—															
East Coolgardie	1,260	27	637	10	1,864	1	429	2	2,121	....	....	....	....	....	....
Bulong	69	3	66	1	114	....	....	....	....	....	....	....	....	....	....
Coolgardie Goldfield—															
Coolgardie	608	14	450	6	1,370	2	1,811	....	....	....	....	....	....	....	....
Kunanalling	196	1	49	....	....	....	....	....	....	....	....	....	....	....	....
Yilgarn Goldfield	479	37	812	6	1,705	....	....	3	4,224	....	....	....	....	....	....
Dundas Goldfield	183	12	180	3	816	....	....	....	....	....	....	....	....	....	....
Phillips River Goldfield	10	2	56	....	....	....	....	....	....	....	....	....	....	....	....
State Generally	11	2	14	....	....	....	....	....	....	....	....	....	....	....	....
Totals	6,376	211	5,890	76	17,620	15	10,596	8	10,592	3	6,770	....	....	....	....

Goldfield and District.	5,000–10,000 ozs.		10,000–20,000 ozs.		20,000–30,000 ozs.		30,000–40,000 ozs.		40,000–50,000 ozs.		50,000–100,000 ozs.		Over 100,000 ozs.	
	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).
Kimberley Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Ashburton Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pilbara Goldfield—														
Marble Bar	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Nullagine	....	....	....	....	....	....	....	....	....	....	....	....	....	....
West Pilbara Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Peak Hill Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East Murchison Goldfield—														
Lawlers	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Wiluna	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Black Range	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Murchison Goldfield—														
Cue	....	....	....	....	....	....	....	....	1	45,792	....	....	....	....
Meekatharra	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Day Dawn	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mt. Magnet	....	....	1	11,517	....	....	....	....	....	....	....	....	....	....
Yalgoo Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mt. Margaret Goldfield—														
Mt. Morgans	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mt. Malcolm	....	....	....	....	1	25,557	....	....	....	....	....	....	....	....
Mt. Margaret	....	....	....	....	....	....	....	....	....	....	....	....	....	....
North Coolgardie Goldfield—														
Menzies	1	5,610	....	....	....	....	....	....	....	....	....	....	....	....
Ularring	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Niagara	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Yerilla	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Broad Arrow Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
North-East Coolgardie Goldfield—														
Kanowna	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Kurnalpi	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East Coolgardie Goldfield—														
East Coolgardie	2	16,917	2	31,475	2	45,734	....	....	1	41,482	2	139,252	1	126,749
Bulong	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Coolgardie Goldfield—														
Coolgardie	....	....	1	16,429	....	....	....	....	....	....	....	....	....	....
Kunanalling	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Yilgarn Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Dundas Goldfield	....	....	....	....	....	....	....	....	1	42,475	....	....	....	....
Phillips River Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
State Generally	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Totals	3	22,527	4	59,421	3	71,291	....	....	3	131,549	2	139,252	1	126,749

TABLE F.

Classification of Gold Output, 1946–1950.

Range of Output.	1950.			1949.			1948.			1947.			1946.		
	No. of Producers.	Production.	Percentage of Total.	No. of Producers.	Production.	Percentage of Total.	No. of Producers.	Production.	Percentage of Total.	No. of Producers.	Production.	Percentage of Total.	No. of Producers.	Production.	Percentage of Total.
		Fine ozs.			Fine ozs.			Fine ozs.			Fine ozs.			Fine ozs.	
Over 100,000	1	126,749	20·9	1	132,984	20·5	1	137,502	20·7	1	141,436	20·1	1	119,992	19·4
50,000 to 100,000	2	139,252	22·9	3	202,381	31·2	3	190,031	28·8	1	94,051	13·4	1	87,343	14·1
40,000 to 50,000	3	131,549	21·6	2	87,936	13·5	1	40,412	6·1	2	86,657	12·2	....	....	....
30,000 to 40,000	....	....	....	1	32,529	5·0	3	74,814	11·3	3	107,047	15·3	3	110,878	18·0
20,000 to 30,000	3	71,291	11·7	2	44,227	6·8	1	22,508	3·4	2	46,415	6·6	3	123,100	19·9
10,000 to 20,000	4	59,421	9·8	5	70,922	10·9	7	107,634	16·2	7	103,154	14·7	5	73,179	11·9
5,000 to 10,000	3	22,527	3·7	2	15,306	2·4	1	5,789	0·9	4	24,826	3·5	5	36,670	5·9
4,000 to 5,000	....	....	....	....	....	....	1	4,225	0·6	1	4,645	0·7	2	9,946	1·5
3,000 to 4,000	....	....	....	1	3,743	0·6	1	3,174	0·5	2	7,448	1·1	....	....	....
2,000 to 3,000	3	6,770	1·1	3	6,275	1·0	3	7,438	1·1	2	4,359	0·6	2	5,234	0·8
1,000 to 2,000	8	10,592	1·7	7	10,089	1·5	7	11,300	1·7	6	8,754	1·2	7	7,929	1·3
500 to 1,000	15	10,596	1·7	24	14,933	2·3	18	11,335	1·7	11	8,428	1·2	13	8,847	1·4
100 to 500	76	17,620	2·9	70	15,734	2·4	96	20,812	3·1	75	16,510	2·4	83	18,528	3·0
Under 100	211	5,890	1·0	194	6,132	0·9	206	6,503	1·0	259	7,805	1·1	272	8,022	1·3
Sundry Claims, etc.	....	6,376	1·0	....	6,381	1·0	....	19,254	2·9	....	41,217	5·9	....	9,391	1·5
Total	329	608,633	100·0	315	649,572	100·0	349	662,740	100·0	376	701,752	100·0	399	618,607	100·0

TABLE G.

Mines Producing 5,000 ounces and upward for the Past Five Years.

Mine.	1950.			1949.			1948.			1947.			1946.		
	Tons Treated.	Ounces Gold.	Dwts. per Ton.	Tons treated.	Ounces Gold.	Dwts. per ton.	Tons treated.	Ounces Gold.	Dwts. per Ton.	Tons Treated.	Ounces Gold.	Dwts. per Ton.	Tons Treated.	Ounces Gold.	Dwts. per Ton.
1. Big Bell Mines, Ltd.	359,082	47,592	2·65	424,525	56,071	2·64	424,584	51,770	2·44	357,623	41,048	2·30	153,588	19,633	2·55
2. Boulder Perseverance, Ltd.	114,443	24,455	4·27	133,000	32,529	4·89	135,832	32,324	4·76	137,456	33,498	4·88	101,144	29,106	5·75
3. Central Norseman Gold Corporation, N.L.	155,822	42,475	5·45	132,930	46,865	7·05	118,763	39,150	6·59	107,750	34,411	6·39	105,640	35,959	6·95
4. Comet Gold Mines, Ltd.	3,525	2,093	11·87	1,859	1,686	18·14	2,471	2,635	21·33	2,768	3,744	27·05	12,075	7,698	12·75
5. Gold Mines of Kalgoorlie	163,829	41,482	5·06	163,552	41,071	5·02	161,516	40,412	5·00	158,337	39,138	4·94	151,871	36,758	4·84
6. Great Boulder Pty., Gold Mines, Ltd.	331,739	79,827	4·81	333,109	83,259	5·00	326,685	81,457	4·99	367,293	94,051	5·15	343,506	87,343	5·09
7. Hannan's North (Broken Hill Pty. Ltd.)	39,166	9,256	4·73	42,490	13,027	6·13	42,963	12,878	6·00	44,307	13,893	6·27	36,504	13,047	7·15
8. Hill 50 Gold Mine, N.L.	44,632	11,517	5·16	49,230	13,128	5·33	50,771	13,417	5·28	50,659	13,673	5·39	44,842	12,819	5·72
9. Kalgoorlie Enterprise, Ltd.	46,940	14,417	6·14	52,489	16,981	6·47	53,884	16,692	6·20	57,277	17,807	6·22	51,112	16,530	6·48
10. Lake View and Star, Ltd.	525,924	122,083	4·64	501,261	130,169	5·19	502,534	131,387	5·23	518,431	141,436	5·46	453,317	119,922	5·29
11. Mountain View Gold N.L.	1,655	2,332	28·18	3,638	6,007	33·02	1,395	5,798	83·12	1,922	12,795	133·14	1,423	4,883	68·63
12. New Coolgardie Gold Mines N.L.	32,154	16,429	10·22	24,062	9,299	7·73	....	....	....	....	....	....	....	....	....
13. North Kalgurli (1912), Ltd.	241,365	59,425	4·92	231,836	63,051	5·44	211,784	56,804	5·36	151,710	44,608	5·87	123,550	38,160	6·18
14. Paringa Mining and Exploration, Ltd.	96,488	17,058	3·54	91,811	17,782	3·87	100,642	22,508	4·47	99,702	21,429	4·39	99,568	22,529	4·52
15. South Kalgurli Consolidated, Ltd.	90,094	21,279	4·72	84,785	20,654	4·87	77,395	19,037	4·93	79,173	19,503	4·93	75,915	18,571	4·89
16. State Batteries	50,871	20,390	8·02	41,171	22,555	10·96	40,634	24,451	12·03	49,168	33,147	13·48	45,477	23,671	10·41
17. The Sons of Gwalia	88,745	25,558	5·76	81,395	23,573	5·79	60,093	18,139	6·03	81,510	24,986	6·13	87,683	27,056	6·17
18. Timoni (Moonlight Wiluna G.M., Ltd.)	11,211	5,610	10·00	....	....	....	....	....	....	....	....	....	....	....	....
Total	2,397,685	563,278	4·70	2,393,143	597,707	5·00	2,311,946	568,859	4·92	2,265,086	589,167	5·20	1,887,215	513,755	5·44
Other Sources (excluding large retreatment plants)	65,737	23,022	9·18	75,154	29,476	7·84	135,599	59,527	8·78	242,220	76,895	6·35	307,262	79,022	5·14
Total (excluding large retreatment plants)	2,463,422	586,300	4·82	2,468,297	627,183	5·08	2,447,545	628,386	5·13	2,507,306	666,062	5·31	2,194,477	592,777	5·40
Golden Horseshoe Sands Retreatment	....	7,661	....	....	10,004	....	....	9,982	....	....	10,648	....	....	8,810	....
Lake View and Star Retreatment	....	4,665	....	....	2,815	....	....	6,113	....	....	7,330	....	....	12,212	....
Wiluna Gold Mines Retreatment	....	503	....	....	3,743	....	....	11,820	....	....	10,262	....	....	....	....
State Batteries Tailings Treatment	....	7,159	....	....	5,827	....	....	6,440	....	....	7,450	....	....	4,808	....
Meekatharra Sands Treatment	....	2,345	....	....	....	....	....	....	....	....	....	....	....	—	....
GRAND TOTAL	2,463,422	608,633	4·94	2,468,297	649,572	5·26	2,447,545	662,741	5·42	2,507,306	701,752	5·60	2,194,477	618,607	3·64

TABLE H.

Development Footages Reported by the Principal Mines.

Goldfield.	Mine.	Shaft Sinking.	Driving.	Cross Cutting.	Rising and Winzing.	Diamond Drilling.	Total.
Peak Hill	Horseshoe	....	73	181	....	98	352
Pilbara	Blue Spec	....	46	22	150	....	218
	Sterling	40	189	50	26	....	305
	Ragged Hills (Lead)	105	167	124	....	....	396
Murchison	Big Bell	....	1,753	1,580	2,050	1,827	7,210
	Hill 50	340	564	395	682	197	2,178
	Mountain View	227	341	....	87	....	655
Mount Margaret	Sons of Gwalia	....	457	465	626	6,106	7,654
	Jessie Alma	....	150	87	28	....	265
	Local Lady	....	....	....	145	....	145
	Democrat	....	50	20	....	....	70
	Boomerang	....	126	21	130	....	277
	Lancefield	135	85	....	80	....	300
	White Horse	58	100	27	....	....	185
North Coolgardie	Porphyry	276	....	190	....	....	466
	Yilgangie Queen	133	200	....	....	....	333
	Timoni	....	536	59	546	....	1,141
East Murchison	Beth Heno	75	52	18	85	....	230
	Apples	....	70	....	140	....	210
	North End	45	190	15	....	....	250
East Coolgardie	Boulder Perseverance	....	2,206	....	1,979	21,092	25,277
	Kalgoorlie Enterprise	....	1,228	288	44	5,191	6,751
	Gold Mines of Kalgoorlie	....	5,061	1,541	2,550	14,287	23,439
	Great Boulder	....	4,319	1,743	2,270	9,115	17,447
	Lake View and Star	....	10,952	2,083	4,740	7,706	25,481
	North Kalgurli	126	4,502	1,586	2,606	13,648	22,468
	South Kalgurli	....	3,002	1,273	801	5,366	10,442
	Paringa	57	3,648	1,552	1,149	16,472	22,878
	Mount Charlotte	....	135	669	148	2,259	3,211
Coolgardie	New Coolgardie	261	2,579	....	672	10,303	13,815
Dundas	Norseman (Pyrites)	....	1,133	129	504	877	2,643
	Central Norseman, Phoenix Mine	123	2,056	167	782	5,980	9,108
	Central Norseman, Princess Royal	410	1,138	5	428	4,377	6,358
Yilgarn	Radio	....	216	....	47	....	263
	Great Western	368	1,085	....	163	1,374	2,990
	Sunshine Reward	66	255	25	....	....	346
	Totals	2,845	48,664	14,315	23,658	126,275	215,757

OPERATIONS OF THE PRINCIPAL MINES.

East Coolgardie Goldfield.—The total ore treated in this Goldfield during 1950 amounted to 1,662,147 tons and the gold yield was 408,169 fine ounces, which is an average of 4.91 dwts. per ton. In the previous year, 1,644,637 tons of ore was treated for a return of 437,405 fine ounces of gold at an average of 5.32 dwts. per ton.

The number of men employed was 3,803 as compared with 3,683 in the previous year.

The production represents just over 67.3% of the total gold produced in the State, the proportion being similar in the previous year.

East Coolgardie District produced 407,920 fine ounces from the treatment of 1,661,174 tons of ore, averaging 4.91 dwts. per ton. Comparison with the figures for the previous year—437,321 fine ounces from 1,643,637 tons averaging 5.32 dwts. per ton—indicates that there has been a slight improvement in the tonnage treated. The total return and the average grade per ton are both lower.

The number of men employed was 3,803 as compared with 3,678 in the previous year.

Lake View and Star with a production of 525,924 tons of ore for a return of 122,083 fine ounces of gold at an average of 4.64 dwt. per ton was again the State's leading producer.

Tonnage treated is slightly higher than for the previous year both total return and average grade being lower.

A feature of the year's operations has been the treatment of old dumps with an average value of 2.07 dwts per ton.

The ore reserve position is very strong, the amount added to ore reserve being approximately equal to the amount mined.

A new lode was found at the 300 foot level of the Lake View mine by diamond drilling. Subsequent development has been encouraging.

Great Boulder treated 331,739 tons of ore for a return of 79,827 fine ounces at an average of 4.81 dwts. per ton. The tonnage is practically as for the previous year but the grade is down by 0.2 dwts. per ton.

Stoping operations were conducted on all ore bodies, the main feature of the development programme being directed towards the preparation of known ore for stoping. Important items have been the driving of a new haulage to connect Hamilton and Edwards Shafts at the 3100 level, and the development of the Ivanhoe East Lode and Ash Lode from Hamilton Shaft.

Skips of 3 ton capacity have been installed at Hamilton Shaft.

North Kalgurli (1912) also increased the tonnage treated to 241,365 tons but grade dropped from 5.44 to 4.92 dwts. per ton, the gold recovered amounting to 59,425 fine ounces.

Sinking of the new main shaft is in progress, the pilot winze being down to the 1200 horizon and the shaft proper completed to 110 feet.

Developments have been good, the location of the extensions of the N.E.B. lode which was a good producer in the Main Shaft workings from the Kalgurli shaft being of particular importance.

A haulage way 8ft. by 7ft. to connect the Kalgurli shaft with the new shaft has been driven at the 1530 foot level. This work has developed a considerable tonnage of payable ore.

No ore was produced from the Croesus Proprietary, the mine being operated on a maintenance basis.

Gold Mines of Kalgoorlie was the only mine at Kalgoorlie to maintain the previous year's rate of production. For the treatment of 163,829 tons of ore they obtained 41,482 fine ounces of gold at an average of 5.06 dwts. per ton. In the previous year they treated 163,552 tons averaging 5.02 dwts for a return of 41,071 fine ounces.

Most of the ore was obtained from the *Oroya South* and smaller tonnages were obtained from the *Iron Duke* and *New North Boulder*.

Development has been satisfactory particularly in the *New North Boulder* and a haulage drive to connect with the Oroya Shaft is in progress at the No. 13 level.

A haulage way to connect the *Iron Duke* shaft to the *True Blue* and *Brown Hill* workings where an extensive development programme is in progress is also in process of construction.

South Kalgurli improved as regards tonnage treated and the grade being only slightly lower; there was also some improvement in the recovered gold. The tonnage treated was 90,094 as against 84,785 and the gold won 21,279 fine ounces as against 20,654 fine ounces. The corresponding figures for the grade of ore are 4.72 dwt. and 4.87 dwt. respectively.

Principal development was on the 2,180 ft. level where driving and stripping of the No. 6 Caunter Lode revealed a further 200 feet of ore which averages 6.75 dwt. per ton over an average width of 8.5 feet.

Mount Charlotte closed down during the year. Both the option holders and another mining company which inspected the property abandoned their interests and it now reverts to the Paringa Company.

Boulder Perseverance with 114,443 tons treated for a recovery of 24,455 fine ounces at an average of 4.27 dwts. was slightly below the previous year when 133,000 tons of ore were treated for 32,529 fine ounces at an average of 4.89 dwt. per ton.

An extensive development programme included 21,000 feet of diamond drilling.

Kalgoorlie Enterprise treated 46,940 tons of ore for a return of 14,417 fine ounces the average grade being 6.14 dwts. per ton. These are slightly below the corresponding figures of 52,489 tons, 16,981 fine ounces and 6.47 dwt. as reported for the previous year

Normal stoping and development continued throughout the year.

Paringa recorded a further decline in grade from 3.87 to 3.54 dwts. and this can leave very little profit margin. The ore treated increased from 91,811 tons to 96,488 tons and the gold won declined from 17,782 fine ounces to 17,058 fine ounces.

A bold policy of development—16,472 feet of diamond drilling and 1,552 feet of crosscutting are reported for the year—is being pursued but it is obvious that it is necessary for this mine to uncover further supplies of ore of good grade if it is to continue.

Hannans North treated 39,166 tons of ore averaging 4.73 dwts. for 9,256 fine ounces of gold. There is a considerable decline from the figures for the previous year when 42,490 tons of ore averaging 6.13 dwts. yielded 13,128 fine ounces.

This mine is nearing the end of its developed ore.

At *Mount Monger* the *Daisy* and *Haoma* both worked throughout the year. The *Daisy* produced 429 fine ounces from 682 tons and the *Haoma* 1,118 fine ounces from 1,610 tons. The *Haoma* has been taken over by a syndicate.

The *Bulong District* produced 249 fine ounces from the treatment of 973 tons of ore.

MURCHISON GOLDFIELD.

Total ore treated was 416,064 tons and the gold recovered was 69,058 which is equal to 3.32 dwts. per ton.

In the previous year the ore treated was 489,112 tons and the gold recovered 81,844 fine ounces, the average being 3.35 dwts. per ton.

The number of men employed was 814 as against 780 in the previous year.

The goldfield ranks as second of the State's gold producers and obtained 11.8 per cent. of the total production.

Cue District with a production of 49,785 fine ounces from 361,901 tons of ore averaging 2.75 dwts. per ton, as compared with 58,381 fine ounces from 427,385 tons of ore averaging 2.73 dwts. in the previous year produced considerably over half the gold, and the principal producer here was the *Big Bell* mine with 47,592 fine ounces of gold from 359,082 tons averaging 2.65 dwts. per ton. The grade is practically as for the previous year but the tonnage is down from 424,525 tons to 359,082 tons, and the yield from 56,071 fine ounces to 47,592 fine ounces.

Big Bell retains its position as fourth of the State's gold producers.

Development of the block of ore between 613 and 800 foot levels has been continued and additional work to improve the ventilation of the mine has been carried out.

Preparation for the introduction of hydraulic fill into the empty stopes is being made.

In the *Meekatharra District* the ore treated was 6,435 tons and the gold won was 4,902 fine ounces, the average being 15.23 dwts. per ton. In the previous year 7,148 tons of ore yielded 3,196 fine ounces at an average of 8.94 dwts. per ton.

The rise in grade is accounted for by the increased output from *Meekatharra Sands Retreatment* which recovered 2,345 fine ounces as against 400 ounces in the previous year.

The principal mines were the *Halcyon* at Meekatharra (1,859 tons for 223 fine ounces); the *New Brew* at Gabanintha (313 tons for 303 fine ounces) and the *Blue Bird* at Yaloginda (945 tons for 255 fine ounces).

The *Day Dawn District* produced 2,519 fine ounces of gold from the treatment of 2,208 tons of ore, averaging 22.82 dwts. per ton. In the previous year the production was 6,260 fine ounces from 3,989 tons of ore averaging 31.39 dwts. per ton.

A decline in output at the *Mountain View* which is the principal producer for the district accounts for the above reduction. The production at Mountain View from 1,655 tons averaging 28.18 dwts. per ton was 2,332 fine ounces as compared with 3,638 tons of ore which yielded 6,007 fine ounces at an average of 33.02 dwts. per ton in the previous year.

Mount Magnet District with 11,854 fine ounces from 45,520 tons averaging 5.21 dwts. per ton is down both in tonnage and grade as compared with 14,005 ounces from 50,591 tons averaging 5.53 dwts. in the previous year.

The main producer is *Hill 50* which treated 44,632 tons of ore averaging 5.16 dwts. per ton for a return of 11,517 fine ounces. In the previous year the treatment of 49,230 tons yielded 13,128 fine ounces, the average grade being 5.33 dwts. per ton.

The new shaft was completed to the full depth of 960 feet and the work of equipping the 600 foot and 800 foot levels is in progress.

The mill was closed towards the end of the year because the crushing screening and conveyor section to connect the new shaft to the plant was not complete.

A considerable amount of the ore treated was remnants of worked out blocks and the ore reserve position is much stronger than at the end of last year.

DUNDAS GOLDFIELD.

The treatment of 158,285 tons of ore yielded 43,654 fine ounces of gold, the average grade being 5.52 dwts. per ton. In the previous year the treatment of 136,311 tons of ore yielded 48,600 fine ounces of gold, the average grade being 7.13 dwts. per ton. Both tonnage and grade are down considerably but this goldfield is still third in order of gold production and was responsible for 7.2 per cent of the total output.

The number of men employed was 452 as against 456 in the previous year.

The only large mine is the *Central Norseman,* which mined and treated 155,822 tons of ore averaging 5.45 dwts. per ton for a return of 42,475 fine ounces of gold. The figures for the previous year were 132,930 tons for 46,865 fine ounces, the average being 7.05 dwts. per ton.

The reduction in grade brought about by lower grade ore from the clean-up of stopes in the *Phoenix* section and some low grade development has caused a reduction of gold produced in spite of a considerable increase in tonnage treated.

The *Regent* shaft has been sunk to an underlay depth of 2,788 feet. This is 112 feet below the No. 27 level to which the skips are now operating.

A bitumen road has been constructed from the *Regent* to the *Phoenix* plant and ore is carted by motor trucks.

An extensive development programme has been carried out. High values were encountered in the *Princess Royal* mine at the 400 foot level.

MOUNT MARGARET GOLDFIELD.

Mines in this goldfield treated 97,602 tons of ore averaging 6.69 dwts. per ton for a recovery of 32,675 fine ounces which is 5.4 per cent. of the State's total output. In the previous year the treatment of 90,755 tons of ore averaging 7.45 dwts. per ton yielded 33,816 fine ounces of gold.

Although the average grade is down by ¾ dwts. per ton there has been a considerable increase in tonnage treated and the return of gold is not a great deal lower.

The number of men employed was 452 as against 479 in the previous year.

Mount Morgans District produced 1,544 ounces of gold from the treatment of 1,438 tons of ore averaging 21.46 dwts. per ton. In the previous year the corresponding figures were 2,532 fine ounces from 1,797 tons of ore at an average of 28.19 dwts. per ton.

The *Democrat* (111 tons for 188 ounces), *Local Lady* (791 tons for 384 ounces), and *North Democrat* (168 tons for 347 ounces) at the Linden were the principal producers. The State Battery at Linden produced 487 fine ounces of cyanide gold.

Mount Malcolm District did well to produce 26,227 fine ounces of gold from the treatment of 89,328 tons of ore averaging 5.87 dwts. per ton; as compared with 26,393 fine ounces from 82,693 tons of ore averaging 6.38 dwts. per ton.

The *Sons of Gwalia* was again the principal producer, with 88,745 tons treated at an average of 5.76 dwts. per ton for 25,558 fine ounces. This is an improvement on last year's figures of 81,395 tons treated at an average of 5.79 dwts. per ton for 23,573 fine ounces. The Gwalia has done very well and returns are the highest for several years.

The Puzzle (143 tons for 120 ounces) at Darlot and the *Jessie Alma* (113 tons for 171 ounces) at Gwalia were the most successful of the other mines.

The *Mount Margaret District* produced 4,905 fine ounces from the treatment of 6,855 tons averaging 14.31 dwts. per ton which compares favourably with 4,891 fine ounces from 6,265 tons of ore averaging 15.61 dwts. in the previous year.

Lancefield maintained its tonnage, the ore treated being 5,761 tons as against 5,276 tons in the previous year but the recovery fell from 769 fine ounces to 396 fine ounces. The recovery by amalgamation has fallen from 2.92 dwts. to 1.38 dwts. per ton.

At Burtville the consistent *Boomerang* recovered 917 fine ounces from 196 tons equal to 93.9 dwts. per ton and the *Happy Find* treated 82 tons averaging 71.8 dwts per ton for a recovery of 295 fine ounces.

The *White Horse* at Mount Barnicoat treated 221 tons for a recovery of 463 fine ounces.

United Gold Recoveries and the State Battery at Laverton together produced 1538 fine ounces of gold by cyanidation.

COOLGARDIE GOLDFIELD.

Coolgardie Goldfield showed an increase on last year's figures, producing 20,913 fine ounces from the treatment of 47,005 tons of ore averaging 8.90 dwts. per ton as compared with 13,664 fine ounces from the treatment of 41,261 tons, of ore averaging 6.62 dwts. per ton.

The gold produced is equal to 3.4% of the total for the State.

The average number of men employed was 384 as compared with 337 in the previous year.

Coolgardie District treated 46,093 tons of ore averaging 8.97 dwts. per ton for a recovery of 20,668 fine ounces, as compared with the previous year when 39,694 tons were treated for a recovery of 13,214 fine ounces, the average return being 6.66 dwts. per ton.

A substantial increase in tonnage as well as an improvement in grade are reported from the *New Coolgardie* which crushed 32,154 tons of ore averaging 10.22 dwts. per ton for a recovery of 16,429 fine ounces as compared with 24,062 tons of ore at 7.73 dwts. per ton for 9,299 fine ounces in the previous year.

The shafts on both *Surprise* and *Barbara* Mines have been deepened and development has discovered ore of good grade.

The *Fairplay* at Higginsville treated 5,726 tons of ore for a recovery of 472 fine ounces and owing to financial losses the mine was closed.

Prospectors were active in the district, the best returns coming from *Victory Explorations,* (1,040 tons for 242 fine ounces) at Bonnie Vale; *Gold Coin* (1,032 tons for 184 fine ounces) and *Squeaker* (541 tons for 159 fine ounces) at Cave Rocks; and the *Jackpot* (413 tons for 174 ounces), at Coolgardie.

There was little activity in the *Kunanalling District* where 913 tons were mined and treated for a return of 325 fine ounces.

NORTH COOLGARDIE GOLDFIELD.

The output from this goldfield was greater than the Yilgarn Goldfield and much greater than that recorded for the previous year.

The ore treated was 18,651 tons and the recovery 11,889 fine ounces, which is equal to 12.75 dwts. per ton.

In the previous year ore treated was 5,347 tons and gold recovered 7,049 fine ounces equal to 26.37 dwts. per ton.

The number of men employed was 331 as against 281 in the previous year.

Menzies District. The *Timoni* mine commenced treatment and recorded the production of 5,610 fine ounces from 11,211 tons of ore at an average of 10.00 dwts per ton.

Ore is mined by shrink stoping and 21,000 tons of ore was broken during the year. Development was satisfactory and a reserve of 128,000 tons of milling grade has been established.

Other activity was confined to small mines.

In the *Ularring District* the treatment of 2,241 tons of ore yielded 1,897 fine ounces of gold at an average of 16.93 dwts. per ton. In the preceding year 1,869 tons of ore yielded 2,712 fine ounces at an average of 29.02 dwts. per ton.

The *Callion* mine at Davyhurst was re-opened during the year and 717 tons of ore which yielded 253 fine ounces of gold was carted to Coolgardie for treatment. The No. 2 level was repaired and sinking of the shaft to the third level is in progress.

The best among the smaller mines were the *First Hit* (155 tons for 361 fine ounces), and the *Mabel Gertrude* (346 tons for 183 fine ounces) at Morley's Find; the *Ajax West* (685 tons for 852 fine ounces) at Mulline; and the *Oakley* (300 tons for 380 fine ounces) at Mulwarrie.

Niagara District produced 689 ounces from the treatment of 811 tons of ore averaging 17.23 dwts. per ton compared with 621 fine ounces from 818 tons averaging 15.18 dwts. per ton in the previous year.

The only noteworthy producer was *Altona* (420 tons for 505 fine ounces) at Kookynie.

Yerilla District was not up to last year's figures. Ore treated was 2,241 tons, average grade 16.93 dwts. per ton and recovery 1,897 fine ounces. In the previous year ore treated was 1,661 tons, average grade 29.90 dwts. per ton and recovery 2,483 fine ounces.

The principal mine is the *Yilgangie Queen* where tributers obtained 1,738 tons of ore which returned 1,546 fine ounces of gold. A new compressor and hoisting plant have been installed and developments have been satisfactory.

Some construction work was done on the *Porphyry* mine.

YILGARN GOLDFIELD.

Production from 41,648 tons amounted to 7,220 fine ounces, the average grade being 3.47 dwts. per ton. In the previous year production from 42,149 tons amounted to 8,287 fine ounces, the average grade being 3.93. dwts. per ton.

The number of men employed was 266 as against 222 in the previous year.

The development of the *Copperhead* mine at Bullfinch by *Great Western Consolidated N.L.* is proceeding satisfactorily. The approach for the open cut is complete, the main shaft has been sunk to 450 feet, installation of surface equipment is well advanced and arrangements for housing of employees have been made in Bullfinch.

The *Radio* mine treated 1,405 tons of ore for a return of 1,331 fine ounces of gold the average return being 18.9 dwts. per ton, as compared with 1,841 tons treated for a return of 1,569 fine ounces at an average of 17.05 dwts. per ton in the previous year. Because of alterations and renewals to the plant no cyanidation was done during the year.

At Marvel Loch the *Burbidge Gold Mines* obtained 1,265 fine ounces from the treatment of 25,400 tons of laterite ore the average grade being just under 1 dwt. per ton.

In the previous year they treated 32,235 tons of ore for a return of 1,982 fine ounces, the average grade being 1.23 dwts. per ton.

The mine has not been able to continue in the face of such low grade head values and was closed toward the end of the year.

Sunshine Reward pushed on with an active development programme completing the new shaft to the 300 foot level where 221 feet of driving was done. The year's production of 1,628 fine ounces obtained from 3,749 tons of ore averaging 8.7 dwts. per ton was down both in tonnage and grade, compared to the previous year when 2,115 fine ounces was obtained from the treatment of 4,364 tons of ore averaging 9.69 dwts. per ton.

The *Cricket* on the south end of these leases was drilled and results were encouraging.

The *Frances Furness* treated 516 tons for a return of 329 fine ounces.

At Parker's Range the *Constance Una* treated some small rich crushings to obtain 372 fine ounces from 181 tons of ore. This mine is electrically lighted underground and has telephonic communication between the surface and underground workings.

The known shoot of values in the *Centipede* was exhausted but exploratory work has been encouraging.

No work was done on the *Scots Greys*.

PILBARA GOLDFIELD.

A further decline in gold produced is reported here. Treatment of 9,735 tons produced 5,408 fine ounces of gold, the average being 11.11 dwts. per ton. In the previous year 5,712 fine ounces of gold was obtained from the treatment of 5,498 tons of ore the average being 20.78 dwts. per ton.

The number of men employed was 147 as compared with 102 in the previous year.

In the *Marble Bar District* the *Comet* at Marble Bar treated 3,525 tons for a return of 2,093 fine ounces the average being 11.86 dwts. per ton as compared with 1,860 tons treated for a recovery of 1,686 fine ounces at an average of 18.13 dwts. per ton. The equipment on this mine has been of service to other smaller mines in the district.

Sterling Gold Mines continued with the development of the *Edilweiss* lease and the erection of a 10-head battery.

In the *Nullagine District* the *Blue Spec* re-opened and the returns show 551 tons of ore treated for 389 fine ounces of gold. Good values are reported from development work at the lower levels. The *Barton* mine treated 764 tons for a return of 656 fine ounces.

BROAD ARROW GOLDFIELD.

In this goldfield the treatment of 3,592 tons of ore averaging 18.8 dwts. per ton yielded 3,376 fine ounces of gold, as compared with 5,053 tons averaging 17.03 dwts. per ton treated for a return of 4,287 fine ounces in the previous year.

The number of men employed was 194 as against 181 in the previous year.

Small mines were active, the most successful being *New Mexico* at Christmas Reefs with 149 tons treated for 862 fine ounces and *Pakeha* at Paddington with 302 tons treated for 208 fine ounces.

YALGOO GOLDFIELD.

The ore treated here amounted to 1,115 tons which yielded 733 fine ounces, the average grade being 13.16 dwts. per ton, as compared with the previous year when 1,771 tons was treated for 793 fine ounces, the average grade being 8.93 dwts. per ton.

The number of men employed was 32 as compared with 36 in the previous year.

PEAK HILL GOLDFIELD.

The ore treated was 1,724 tons and the gold recovered was 564 fine ounces, equal to 6.55 dwts. per ton. In the previous year 1,166 tons of ore was treated for a recovery of 585 fine ounces, the average being 10.03 dwts. per ton.

The number of men employed was 28 as compared with 38 in the previous year.

Anglo Westralian Mining Pty. Ltd. has exercised the option it held over the *Horseshoe Lights* and now operates the mine as *Horseshoe Gold Mine*. The establishment of a plant has been commenced.

NORTH-EAST COOLGARDIE GOLDFIELD.

Production from 972 tons of ore amounted to 406 fine ounces at an average of 8.36 dwts. per ton. In the previous year 1,321 tons of ore was treated for a return of 511 fine ounces at an average of 7.74 dwts. per ton.

The number of men employed was 44 as compared with 49 in the previous year.

KIMBERLEY GOLDFIELD.

The production of 1,241 fine ounces of specimen gold including 1,034 fine ounces from the *New Look* was reported.

ASHBURTON GOLDFIELD.

The only operating mine was the *Star of the West* which produced 44 fine ounces of gold from the treatment of 127 tons of ore.

PHILLIPS RIVER GOLDFIELD.

The total production of gold from this goldfield was 65 fine ounces, of which 20 fine ounces was obtained from the concentration plant operated by Wehr Bros. at Ravensthorpe.

WEST PILBARA GOLDFIELD.

The total production of gold was 115 fine ounces mainly from the operations of prospectors.

GASCOYNE GOLDFIELD.

No production was reported.

MINERALS OTHER THAN GOLD OR COAL.

The value of minerals other than gold or coal produced during the year was £677,894. This value is based on the shipments finalised during the year. It includes shipments in transit at the end of 1949 but not those in transit at the end of 1950. The value of precious metals recovered from base metal ores and concentrates is included.

The value of exported minerals is calculated on an F.O.B. basis at Fremantle or other port of shipment; and that of minerals which are used in Australia is calculated on an F.O.R. basis at point of loading.

The value of the corresponding production for 1949 was £645,001.

Silver included in gold bullion, which totalled 198,210 fine ounces was valued at £57,984. In the previous year gold bullion contained 194,721 fine ounces, valued at £49,246.

In the following table the production of the principal minerals during 1950 is compared with the corresponding figures for 1949.

Considerable increases in tonnage are recorded for copper, felspar, gypsum, iron, manganese, pyrite and tin.

PRINCIPAL MINERALS OTHER THAN GOLD AND COAL.

Mineral.	1950.		1949.	
	Tons.	Value. £A.	Tons.	Value. £A.
Antimony	92·10	3,514	21·68	954
Asbestos	1,230	152,677	1,297	125,332
Beryl	16·93	1,431	20·45	1,497
Clays	6,439	4,936	10,047	11,813
Copper	972	9,050	303	3,451
Dolomite	320	1,268	50	248
Felspar	1,421	5,329	1,049	3,934
Glass Sand	5,132	3,566	986	1,014
Glauconite	1,618	8,735	1,018	5,287
Gypsum	30,835	21,942	25,907	18,610
Iron	14,895	82,682	12,524	66,295
Lead	1,866	113,308	2,922	154,777
Magnesite	1,829	3,825	2,034	4,714
Manganese	11,962	65,459	9,420	56,289
Mica	....	....	....	1,343
Pyrite	35,213	163,514	31,299	125,857
Red Ochre	186	1,860	44	366
Talc	256	2,700	181	2,375
Tantalite, etc.	6·69	2,858	....	286
Tin	51·41	25,496	34·66	13,079
Vermiculite	120	720	162	987
Total	....	674,870	....	598,508
Silver (in gold bullion)	....	57,984	....	49,246
Other Minerals	....	3,024	....	46,493
Total	....	735,878	....	694,247

Notes on the various minerals are given below.

Antimony.

Production of gold-antimony concentrate has been resumed at the Blue Spec mine and a few tons of high grade ore has also been won from the Nullagine district.

Asbestos.

Australian Blue Asbestos produced 1,018 tons valued at £143,496 as compared with 1,156 tons valued at £116,828 in the previous year. There has thus been a considerable increase in the unit price.

The establishment of the town in the vicinity of the mine is now an accomplished fact and a substantial increase in output for the coming year is anticipated.

L. G. Hancock produced 211 tons of Chrysotile fibre, valued at £9,157, from the Nunyerry mine. In the previous year he produced 141 tons valued at £8,503. The apparent reduction in unit price is due to the inclusion of a larger percentage of short fibre, some from accumulated stocks, in this year's production.

One ton of fibre from Nunyerry reported as Tremolite was found, on testing, to be Anthophyllite.

Barytes.

The demand for this mineral is limited. A deposit at Cranbrook produced 16 tons valued at £56.

Bentonite.

The Marchagee deposits yielded 213 tons valued at £599.

Beryl.

Production declined from 20.45 tons in 1949 to 16.93 tons in this year. The average grade was 11 per cent. BeO and the average unit price £7 13s. 8d. Yinnietharra, the principal centre of production, yielded 12.19 tons and 3.75 tons was obtained from Cooglegong. Production from the Wodgina area amounted to 0.99 tons.

Clays.

The total production of various clays amounted to 6,439 tons valued at £4,936. In the previous year the production amounted to 10,047 tons valued at £11,813.

The decrease is due principally to a lower output of pottery clay from the Goomalling pits operated by Brisbane & Wunderlich Ltd. The deficiency has been made up from accumulated stocks and the output will be increased again when conditions are favourable.

Copper.

There has been considerable prospecting activity and small parcels of carbonate ores have been won from several localities. The total amount of copper bearing material used in fertilisers was 969.85 tons of which 6.97 tons was concentrate, the remainder being carbonate ore. A parcel of copper matte containing .84 tons of copper was obtained at Eulaminna and 2.50 tons of gold copper concentrate besides 6.97 tons of copper concentrate used in fertiliser was obtained from Ravensthorpe.

Dolomite.

Production of 319.85 tons valued at £1,268.25 represents a considerable increase over the corresponding figure of 49.5 tons valued at £248 in the previous year.

In addition to the regular supply to local steel foundries some dolomite has been supplied to Wundowie Charcoal Iron for flux.

Felspar.

Australian Glass Manufacturers produced 1,421 tons valued at £5,328.75 as compared with 1,049 tons valued at £3,934 in the previous year.

Glass Sand.

A very considerable increase has been recorded. The production for 1950 was 5,132.25 tons valued at £3,565.71 as compared with 986 tons valued at £1,014 in the previous year. Australian Glass manufacturers operating in this area for the first time obtained 4,565.85 tons.

Glauconite.

Regular production was continued at the Gingin deposit where 1,617.50 tons of Greensand valued at £8,734.50 was obtained as compared with 1,018 tons valued at £5,287 in the previous year. The contained Glauconite is equivalent to 20 per cent. of the tonnage of greensand.

Gypsum.

Production increased from 25,907 tons in 1949 to 30,835.40 tons in 1950 and the value from £18,610 to £21,942.35. The production of plaster of paris for the year amounted to 22,424.25 tons.

Ilmenite.

A parcel of beach sands amounting to 84 tons and valued at £521 was obtained from Cheyne Bay.

Iron Ore.

The Wundowie Charcoal Iron Industry smelted 14,895.23 tons of ore of which 3,069.86 tons was obtained from Koolyanobbing and 11,825.25 from Wundowie. The pig iron recovered was 7,725.64 tons valued at £82,682.37.

In the previous year 12,524 tons of Wundowie ore was smelted for 6,609 tons of pig valued at £66,296.

Lead.

The total reported production of lead ore and concentrates containing lead silver and zinc amounted to 1,865.79 tons valued at £113,307.93. In the previous year the corresponding figures were 2,922 tons of ore valued at £154,776. This year's shipments contained 1,301.64 tons of lead, 254 tons of zinc and 6,685.26 ounces of silver.

Northampton and Galena districts produced 1,035.05 tons of ore and concentrates containing 726.60 tons of lead. The average grade being a little over 70 per cent. Ores from these districts contain very little silver.

The principal producer was the Protheroe Mine at Nabawa which produced 369.03 tons of concentrate averaging 75.6 per cent. and containing 279.41 tons of lead. The mine has been taken over by Anglo-Westralian Pty. Ltd. and the treatment plant was closed down to permit reconstruction for a considerable part of the year.

Mines in the Ashburton goldfield at Uaroo, Kooline and Wyloo produced 347.86 tons of ore and concentrates containing 244.23 tons of lead and 2,597.11 ounces of silver equivalent to 70.5 per cent. lead and 7.5 ounces of silver per ton.

The Pilbara area produced 445.22 tons of concentrate, of which 430.66 tons obtained by R. O. Moore from his mine at Braeside, contained 301.27 tons of lead and 3,909.06 ounces of silver equivalent to 69.5 per cent. lead and 13 ounces of silver per ton. Anglo-Westralian Pty. Limited are also interested in this mine.

Lead zinc ores with some silver were obtained from the Napier Range in the Kimberleys and from the Ethel Maud mine at Galena. The total production of 37.66 tons contained 22.20 tons lead, 2.54 tons zinc and 99.85 ounces of silver.

The price per ton of concentrate averaged £60 as compared with £53 in the previous year.

Manganese.

The Peak Hill deposits yielded 11,961.64 tons of manganese ore valued at £65,459.33. In the previous year 9,420 tons valued at £56,289 was produced.

Pigments.

The production of ochre amounted to 185 tons valued at £1,860, all of which came from the Weld Range, as compared with 44 tons valued at £366 in the previous year.

Pyrites.

Norseman Gold Mines recorded a slightly higher production—35,213 tons as compared with 31,299 tons—and the contained sulphur amounted to 15,029.57 tons as compared with 12,981 tons. Value increased from £125,857 to £163,514.

Silver.

The silver in gold bullion amounted to 198,210.43 ounces and that in lead ores and concentrates to 6,685.26 ounces, the total production being 204,895.69 ounces. Production in the previous year was 204,713 ounces.

Talc.

A parcel of 56 tons from Mt. Monger realised £210 and 200 tons from Three Springs realised £2,490.

Tantalite and Columbite.

Buyers are now paying for both Tantalum and Columbium oxides and are also buying the tantalum and columbium content of tin concentrates. The production for the year was 6.69 tons containing 389.91 units of combined oxide. The value is estimated at £2,857.85.

Tin.

The Pilbara district produced 21.07 tons of concentrate including 9.34 tons from J. A. Johnston's sluicing plant at Cooglegong and 11.23 tons from sundry persons including native fossickers.

Greenbushes produced 30.34 tons including 15.04 tons from Spring Valley Tin, which operated its sluicing plant throughout the year; F. D. Freeman produced 9.51 tons and Greenbushes Mineral Syndicate 5.79 tons.

The total production was 51.41 tons valued at £25,495.85 as compared with 34.66 tons valued at £13,079 in the previous year.

Vermiculite.

Perth Modelling Works obtained 120 tons valued at £720 from their Holdings at Young River. They processed 59 tons of raw material for a return of 46.25 tons of ex-foliated material and exported 63.75 tons of crude ore.

E. E. BRISBANE,
Assistant State Mining Engineer.

Appendix No. 1.

REPORT ON ACTIVITIES OF EXAMINERS FOR UNDERGROUND SUPERVISORS' AND MINE MANAGERS' CERTIFICATES FOR 1950.

School of Mines,
Kalgoorlie.

22nd January, 1951.

The Chairman, Board of Examiners for Underground Supervisors' and Mine Managers' Certificates, Mines Department, Perth.

I hereby submit the annual report on the work of the Board of Examiners for Certificates for Underground Supervisors and Mine Managers for the year 1950.

Mr. J. F. Breen, a member of the Board, was away for some time during the year, on a visit to America, and Mr. H. B. Newman acted for him during his absence.

Reciprocity.—The Board was pleased to receive advice that the Queensland Board of Examiners for Mine Manager's Certificates had agreed to grant reciprocity between their Metalliferous Mine Managers' Certificates and the Western Australian Mine Managers' Certificates.

The New South Wales Board of Examiners advised that they could not agree to the conditions (a), (b) and (c) as set out in the regulations but would be prepared to recognise all first class Mine Managers' Certificates obtained by an examination conducted by a Board of Examiners set up by the Mines Department of Western Australia. In view of this decision the Board of Examiners decided that recognition would not be granted to the New South Wales Certificates of Competency unless the qualifications of the applicant otherwise conform with those called for under the regulations in force in this State.

No decisions have yet been given by the Boards of Examiners in Victoria and Tasmania.

An examination in Mining Law was held on April 17th, 1950, the results of which were as follows:—

Number entered	19
Number passed	13

Following are the names of the successful candidates:—

Boundy, C. A.	Mt. Magnet
Collin, A.	Norseman
Compton, G. R.	Fimiston
Hamilton, F. G.	Kalgoorlie
Hurse, J. P.	Celebration
Huxtable, D. A.	Kalgoorlie
Ibbotson, G. R.	Kalgoorlie
Jensen, H. E.	Fimiston
Lee, G. S.	Boulder
Paterson, R. B.	Kalgoorlie
Rainsford, G. H.	Kalgoorlie
Thomson, L. D.	Boulder
Wreford, P. M.	Kalgoorlie

Applications for Mine Managers' Certificates of Service numbered 47, resulting as follows:—

Approved	39
Deferred	1
Refused	7

Following are the names of the successful applicants:—

Annear, H. E.	McCahon, J. H.
Antony, J. D.	Mackay, D.
Aylward, T. J.	Madison, J. M.
Beilken, F. J.	Mansfield, L. L.
Boyland, J.	Mincham, P. S.
Broadhurst, C. H.	Morris, L. W.
Carroll, A.	Norman W. S.
Clayton, L. E.	Quartermaine, H. J.
Collins, R. G.	Riley, R. E.
Crocker, H. M.	Rogers, W.
Davis, F. A.	Rowe, H. V.
Dunlop, D.	Smith, A. A.
Duthie, S. H.	Stubbs, R. H. C.
Dutton, W. L.	Taffe, J. M.
Fox, J. J.	Toomey, A. G.
Hadwiger, L. C.	Verran, J. H. C.
Hardy, J. G.	Wiseman, F.
Ley, J. B.	Wood, I. A.
Lloyd, J. E.	Woosnam, W. H.
McArdell, J. O. O.	

Applications for Mine Managers' Certificates of Competency totalled 30, with the following result—

Approved	24
Deferred	6

The names of the successful applicants are as follows—

Adams, C. F.	Jensen, H. E.
Boundy, C. A. P.	Kennedy, H. L.
Brisbane, E. E.	Lee, G. S.
Compton, G. R.	Leevers, J. C.
Crocos, A. J.	Rainsford, G. H.
Dutton, W. L.	Royle, P. G.
Espie, F. F.	Ryan, M.
Haddow, J. F.	Schulz, E. A.
Hamilton, F. G.	Wilson, A. Y.
Holly, J.	Wood, I. A.
Huxtable, D. A.	Wreford, P. M.
Ibbotson, G. R.	Yates, C.

An examination for Underground Supervisors' Certificates was held on October 6th, 1950, the results being as follows—

Number entered	37
Number passed	27

The names of the successful candidates are as follows:—

Bagworth, B. O.	Morton, N. R.
Belingheri, L.	Parker, H. G.
Bermingham, A. T.	Philippe, L. J.
Branson, J. N.	Pickering, F. J.
Coles, E. T.	Reibel, G.
Floyd, J.	Smith, F. B.
Foster, L. A.	Tagliaferri, B.
Gray, C. W.	Thomas, A. D.
Hayes, F. E.	Trapp, J. H.
Lloyd, J. K. N.	Varis, M. C.
McQuillan, H. J.	Willis, C. F.
Mann, J. R.	Wilson, W. L.
Miller, J. F.	Worcester, W. C.
Morton, J. L.	

One duplicate Underground Supervisor's Certificate was issued during the year.

G. M. LUMB,
Secretary, Board of Examiners.

Appendix No. 2.

AUTHORISED MINE SURVEYORS.

The following new applicants were issued with Authorised Mine Surveyors' Certificates under the provisions of Regulation 226, Mines Regulation Act, 1946:—

	Certificate No.
Abotomey, John	64
Denham, Ken E.	61
Forster, Edwin Tinsley	57
Lloyd, John Ken. Neil	60
Olds, Harold Leslie	62
Power, Francis W. G.	59
Weedon, Rodney P. John	63

The following applicant, who was previously registered, was issued with a Certificate:—

	Certificate No.
Powell, Thomas	58

One applicant was refused a Certificate.

JOHN S. FOXALL,
State Mining Engineer,
Chairman of Survey Board.

Index to State Mining Engineer's Annual Report for 1950.

LIST OF TABLES.

Division III.

Report of the Superintendent of State Batteries.

UNDER SECRETARY FOR MINES:

For the information of the Hon. Minister I submit my report on the operation of State Batteries for the year ending 31st December, 1950.

Seventeen batteries crushed 50,871 tons for an estimated yield of £426,831 as against 41,171 tons and £331,727 for the previous year.

The grade of ore crushed showed an appreciable decline being 12 dwts. 4.2 grains per ton as against 15 dwts. 12.6 grains for 1949. This is accounted for by the fact that the rise in the price of gold following the Sterling devaluation of September, 1949 made it possible to mine lower grade ore at a profit. Rapidly rising costs towards the end of the year have, however tended to nullify this advantage and it is expected that the grade of ore treated may rise somewhat this year.

Particulars of the grade of ore at individual batteries is shown on Schedule 2 attached to this report and it will be seen that ore crushed at Ora Banda, Sandstone and Cue was considerably above the average with values of 35 dwts. 9 grains, 25 dwts. 5 grains and 18 dwts 23 grains per ton respectively.

The cyanidation of 45,843 tons of tailings resulted in a working profit of £13,413 11s. 11d. while the loss on milling was £38,122 0s. 2d. The nett operating loss is therefore £24,708 8s. 3d. compared with £18,888 12s. 9d. for 1949, and these figures do not include depreciation or interest.

Capital expenditure was £8,913 17s. 3d. from General Loan Funds and £8,950 17s. 7d. from Consolidated Revenue.

Schedules are Attached as Listed.

Schedule—

1. Yield and gross value.
2 and 3. Details of tailing treatment.
4. Milling Costs.
5. Tailing treatment costs.

Tonnages crushed and cyandided for the last three years are as follows:—

	1948.	1949.	1950.
Crushed	40,634	41,171	50,871
Cyanided	39,958	33,010	45,843

Estimated Value of Production since Inception excluding Value of Gold Tax paid to the Commonwealth.

	£
Par Production—	
Amalgamation	7,997,652.053
Cyanidation	1,966,417.557
Gold Premium—	
Amalgamation	3,330,640.015
Cyanidation	995,998.038
Tin Production—	
Ore	93,883.16
Residues	572.000
	£14,385,162.823

Production Details.

Six hundred and eighty parcels were milled averaging 74.81 tons per parcel compared with 544 averaging 75.68 tons in 1949.

Comparative Values for 1949 and 1950 are:—

	1949. ozs.	1950. ozs.	£
Amalgamation Bullion	26,629	24,049	315,820
Cyanidation Fine gold	5,827	7,159	111,011
			£426,831

Grade of Ore Treated.

It is estimated that the 24,049 ozs of bullion produced by amalgamation contained 20,391 fine ounces or 8 dwts. 0.4 grains per ton on 50,871 tons. The average assay value of tailings produced was 4 dwts. 3.8 grains bringing the overall value to 12 dwts. 4.2 grains per ton.

Estimated Percentage Recovery.

Approximately 6 per cent. of the tailing produced during the year was cupiferous, and therefore was not treated. Applying the average extraction at tailing plants of 75.42 per cent. to the average tailing value of 4 dwts. 3.8 grains the estimated percentage of extraction is as below:—

	dwts.	grs.	%
Head Value	12	4.2	100.00
Amalgamation recovery	8	0.4	65.84
Cyanidation recovery	3	3.1	25.70
Total recovery	11	3.5	91.54

Milling.

One 15 stamp, eight ten stamp, and eight five stamp mills treated ore for the public. Linden is now the only mill operated by a Lessee.

Cost of Crushing.

The gross working cost including administration increased to 24s. 8d. per ton as against 22s. 8d in 1949. Schedule 4 shows that Kalgoorlie which crushed 12,434 tons or 24 per cent. of the total had the best cost figure at 17s. 1d. per ton. Laverton with a figure of 19s. 2d. per ton was the only other battery below 20s.

Tailing Treatment.

Eleven plants handled 45,843 tons, Kalgoorlie heading the list with 10,270 tons. The average value of all tailing treated was 4 dwts. 3.6 grains and the estimated residue 23.3 grains giving an actual extraction of 75.42%. The previous years figures were 4 dwts. 12.7 grains, 23.84 grains and 78.06% respectively.

Cost of Treatment.

The cost per ton rose from 16s. 1.1d. in 1949 to 19s. 1d., an all time high. Yarri and Kalgoorlie had the best cost figures of 15s. 1d. and 15s. 5d. respectively. Repairs, renewals, administration and sundries amounted to £9,099 11s. 9d. or 3s. 11d. per ton.

Receipts.

Revenue amounted to £58,738 15s. 4d. or 25s. 7d. per ton and at 2s. 11d. per ton above the 1949 figure, was another all time high.

The percentage of payable tailing or that over 2 dwts. 8 grains was approximately 2% below the 1949 figure.

Comparative synopsis of results at State Batteries for twelve months ended 1949 and 1950.

	1949.			1950.		
	Tons.	Cost per ton.	Revenue.	Tons.	Cost per ton.	Revenue.
		s. d.	s. d.		s. d.	s. d.
Milling	41,171	22 7·9	9 2·1	50,871	24 8	9 9
Cyaniding	33,010	16 1·1	22 8·1	45,843	19 1	25 7

RECEIPTS AND EXPENDITURE, 1950.

	Tons.	Expenditure.	Receipts.	Profit.	Loss.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.
Milling	50,871	63,045 2 9	24,923 2 7	....	38,122 0 2
Cyaniding	45,843	43,826 2 1	57,239 14 0	13,413 11 11	....
	....	106,871 4 10	82,162 16 7	....	24,708 8 3

CARTAGE SUBSIDIES.

State Plants.

Subsidies were paid on 18,277¾ tons and amounted to £7,718 16 7.

Private Plants.

Cartage subsidies including feeding subsidies amount to £527 10 2 for 1247¾ tons. Comparative figures for the last three years are as below:

	State Plants.				Private Plants.		
	Total.	Subsidy.	Subsidy.	Cost.	Subsidy.	Cost.	Total Cost.
	tons.	tons.	%	£ s. d.	tons.	£ s. d.	£ s. d.
1948	40,634	16,367	40·2	7,756 6 7	3,114	1,393 8 2	9,149 14 9
1949	41,171	9,818	23·8	4,612 4 0	1,729	693 17 7	5,306 1 7
1950	50,871	18,278	35·9	7,713 16 7	1,247	527 10 2	8,246 6 9

CAPITAL EXPENDITURE.

The total was £17,864 14s. 10d. of which £8,913 17s. 3d. was charged to General Loan Fund and £8,950 17s. 7d. to Consolidated Revenue Fund.

The details are as below:

Item.	General Loan Fund.	Consolidated Revenue Fund.
	£ s. d.	£ s. d.
Boogardie	....	2 16 6
Coolgardie reconstruction	....	2,058 16 4
Cue curvilinear table	348 0 0	59 1 11
Lake Darlot reconstruction	....	2,696 13 3
Purchase of horses	....	18 0 0
Kalgoorlie A.C. electrical conversion	....	397 18 2
Laverton auxiliary engine	....	....
Laverton cyanide vats	363 18 4	....
Marvel Loch purchase price	6,000 0 0	200 18 2
Marvel Loch rehabilitation	517 2 9	944 1 2
Norseman electrification	741 7 0	137 19 1
Peak Hill Power Plant	....	400 0 0
Portable conveyors	943 9 2	....
Utilities	....	1,863 3 2
Yarri Buildings	....	171 9 10
	£8,913 17 3	£8,950 17 7

STAFF.

From 1st January 1950, the duties of Superintendent were taken over by me following the retirement of Mr. D. F. Browne, who had spent all of his working life in the Service. After taking his diploma in Metallurgy at the Bairnsdale School of Mines he was appointed to Mulline in August, 1904, and held positions as Assayer, Manager, Inspector, and was appointed Superintendent on 17th December, 1931. It will be noted that during his term as Superintendent Mr. Browne had the unenviable task of coping with the Depression followed by the War and its aftermath. In the depression, labour and supplies were cheap and plentiful, but money was extermely scarce. During the war, labour, supplies and money were all scarce. Recently money has not been so hard to get but labour and supplies are now the bugbear. The ideal of a simultaneous sufficiency of all three never seems to materialise. Desmond Browne grew up with the service, and to his sound training and experience was added a love of the back country and an outstanding personality. These qualities, combined with his association with the State Battery Service in its early formative years, enabled him to weld it into an efficient unit which has now long been accepted as an important unit in the economic life of the Goldfields.

Manager Simonds of Laverton resigned and his place was taken by Manager Young. Manager Bassford of Meekatharra also resigned and was succeeded by Manager Clemesha. The recently acquired Marvel Loch mill was in the hands of Manager Mack for a short time, who returned to the Boogardie circuit to be succeeded at Marvel Loch by Manager Chegwidden.

General Remarks.

The most worrying feature of the Goldmining Industry today is the rapid increase in costs. 1950 was the first complete year of operations on which to judge the effect of the increase of the gold price from £10 15s. 3d. per ounce to £15 9s. 10d. Though our losses have mounted we have not passed any of them on to the prospector, so that in this respect we have borne part of the brunt of inflation for the small operator whereas the large Companies have had to face up to higher milling as well as mining charges. If the spiral maintains its present rate of acceleration without some corresponding upward movement in the price of gold, the whole industry will be in a serious position in another twelve months.

C. Adams,
Superintendent of State Batteries.

SCHEDULE 1.

Number of Parcels Treated, Tons Crushed and Head Value for the Year ended 31st December, 1950.

No. of Parcels Treated.	Battery.	Tons Crushed.	Yield by Amalgamation. (Bullion.)	Yield by Amalgamation. (Fine Gold.)	Gross Contents of Tailings on 100% (including refractory).	Total Contents of Ore. (Fine Gold.)	Average per Ton (Fine Gold.)	Gross Value per Ton at £4 4s. 11½d. per Ounce.
			ozs. dwt.	ozs. dwt.	ozs. dwt.	ozs. dwt.	dwt. grs.	£ s. d.
18	Bamboo Creek	1,556	745 9	632 1	290 13	922 14	11 20	2 10 3
23	Boogardie	769	271 16	230 10	157 13	388 3	10 2	2 2 10
82	Coolgardie	4,649½	1,737 3	1,472 19	673 12	2,146 11	9 5	1 19 1
68	Cue	5,105½	4,347 12	3,686 7	1,157 15	4,844 2	18 23.	4 0 6
150	Kalgoorlie	12,208	3,226 1	2,735 7	1,738 16	4,474 3	7 8	1 11 2
53	Laverton	6,681½	2,955 16	2,506 4	2,184 12	4,690 16	13 16	2 18 1
14	Marble Bar	758½	270 9	229 6	442 0	671 6	17 17	3 15 3
52	Marvel Loch	3,259½	1,059 10	898 7	401 12	1,299 19	7 23	1 13 10
46	Meekatharra	4,478½	2,525 17	2,141 13	811 16	2,953 9	13 5	2 16 1
3	Mt. Ida	210	72 0	61 1	40 16	101 17	9 17	2 1 3
66	Norseman	2,209	740 11	627 18	409 2	1,037 0	9 9	1 19 10
34	Ora Banda	1,694½	2,091 7	1,773 5	1,227 0	3,000 5	35 9	7 10 3
14	Paynes Find	1,065½	795 8	674 8	107 12	782 0	14 16	3 2 4
6	Peak Hill	1,347½	397 3	336 15	148 10	485 5	7 5	1 10 7
4	Sandstone	375	442 10	375 4	97 14	472 18	25 5	5 7 1
15	Wiluna	2,092½	317 9	269 3	480 8	749 11	7 4	1 10 5
32	Yarri	2,231	2,053 4	1,740 18	212 4	1,953 2	17 12	3 14 4
680		50,871	24,049 5	20,391 6	10,581 15	30,973 1	12 4	2 11 8

Average Tons per parcel	74·81.
Average Yield by Amalgamation per ton (fine gold)	8 dwts. 0·4 grs.
Average Value by Amalgamation per ton	£1 14s. 1d. Australian £6 4s. 3d.
Average Head value of tailing (fine gold)	4 dwts. 3·8 grs.
Average value of tailing per ton	17s. 8d. Australian £2 6s. 9d.

SCHEDULE 2.

Details of Extraction—Tailing Treatment, 1950.

Battery.	Tons Treated.	Head Value.	Contents.	Tail Value.	Contents.	Recovery.	Call.	Recovery.	Shortage.	Surplus.
		dwts. grs.	dwts.	dwts. grs.	dwts.	%	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Bamboo Creek	1,400	3 8	4,704	 21	1,256	75	773 16 7	739 17 2	33 19 5	....
Coolgardie	6,174	4 0	24,555	1 1	6,429	74	4,004 0 2	3,745 7 2	258 13 0	....
Cue	4,313	4 2	17,574	 19	3,339	81	3,022 17 11	3,093 8 2	....	70 10 3
Kalgoorlie	10,270	2 21	29,742	 16	6,729	77	4,887 18 4	5,009 1 9	....	121 3 5
Laverton	6,104	6 16	40,631	1 10	8,819	78	6,770 2 3	6,914 17 10	....	144 15 7
Meekatharra	4,086	3 7	13,407	 22	3,836	71	2,185 7 11	1,952 19 4	232 8 7	....
Norseman	4,760	3 4	15,193	 18	3,556	76	2,487 9 3	2,392 8 6	95 0 9	....
Ora Banda	2,410	8 21	21,434	2 2	4,981	77	3,489 15 9	3,358 16 6	130 19 3	....
Peak Hill	978	2 0	1,986	 12	475	76	338 1 11	337 15 8	6 3	....
Wiluna	2,912	5 4	15,042	1 5	3,541	76	2,297 12 9	2,226 5 1	71 7 8	....
Yarri	2,436	2 11	6,006	 16	1,633	73	910 6 2	931 3 9	....	20 17 7
	45,843	4 3·6	190,274	.... 23·3	44,594	76·56	31,167 9 0	30,702 0 11	465 8 1	....

Head Value	4 dwts. 3·6 grains.
Tail Value	23·3 grains.
Theoretical Recovery	76·56%.
Actual Recovery	75·42%.

SCHEDULE 3.

Cyanide Yield, 1950.

Battery.	Tons.	Fine ozs.	Value.	Premium.	Total.
			£	£	£
Bamboo Creek	1,400	171·93	735·132	1,933·074	2,668·206
Coolgardie	6,174	838·32	3,562·590	9,426·177	12,988·767
Cue	4,313	729·33	3,098·135	8,200·502	11,298·637
Kalgoorlie	10,270	1,179·04	5,009·085	13,256·943	18,266·028
Laverton	6,104	1,611·08	6,914·888	18,114·446	25,029·334
Meekatharra	4,086	459·78	1,952·965	5,169·591	7,122·556
Norseman	4,760	558·02	2,392·423	6,274·354	8,666·777
Ora Banda	2,410	789·62	3,358·823	8,878·740	12,237·563
Peak Hill	978	79·53	337·783	894·129	1,231·912
Wiluna	2,912	524·10	2,226·253	5,893·002	8,119·255
Yarri	2,436	217·95	931·187	2,450·608	3,381·795
Total	45,843	7,158·70	30,519·264	80,491·566	111,010·830

SCHEDULE 4.

Statement of Receipts and Expenditure for Year ended 31st December, 1950.

MILLING.

Batteries.	Tonnage Crushed.	EXPENDITURE.									RECEIPTS.		Profit.	Loss.
		Management.	Wages.	Stores.	Total Working Expenditure.	Cost per Ton.	Repairs and Renewals.	Sundries.	Gross Expenditure.	Cost per Ton.	Receipts.	Receipts per Ton.		
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.
Bamboo Creek	1,596	303 7 1	1,512 11 9	439 17 2	2,255 16 0	28 3	261 13 0	262 1 2	2,779 10 2	34 10	846 16 1	10 7	....	1,932 14 1
Boogardie	769	135 12 9	670 7 11	196 1 3	1,002 1 11	26 1	162 18 7	217 6 5	1,382 6 11	35 11	411 1 8	10 8	....	971 5 3
Coolgardie	4,489½	242 5 2	2,342 5 2	948 12 1	3,533 2 5	15 9	405 3 1	773 16 2	4,712 1 8	21 0	2,255 17 11	10 1	....	2,456 3 9
Cue	5,105½	361 3 11	2,904 6 2	1,233 17 2	4,499 7 3	17 8	882 0 5	650 17 8	6,032 5 4	23 8	2,484 8 9	9 9	....	3,547 16 7
Kalgoorlie	12,434½	977 18 9	3,432 19 8	3,742 12 7	8,153 11 0	13 2	706 10 1	1,743 14 10	10,603 15 11	17 1	5,463 3 1	8 9	....	5,140 12 10
Laverton	6,937½	437 19 8	3,705 5 11	917 0 7	5,060 6 2	14 7	630 3 1	966 7 11	6,656 17 2	19 2	3,550 7 8	10 3	....	3,106 9 6
Linden	....	....	....	....	....	....	1 19 3	....	1 19 3	....	62 1 9	....	60 2 6	....
Marble Bar	758½	205 12 7	673 2 8	335 19 0	1,214 14 3	32 0	241 3 3	236 2 3	1,691 19 9	44 8	425 5 3	11 3	....	1,266 14 6
Marvel Loch	3,259½	301 12 11	1,740 12 6	899 13 1	2,941 18 6	16 8	315 2 4	549 19 4	3,807 0 2	23 4	1,574 1 11	9 8	....	2,232 18 3
Meekatharra	4,444½	523 1 10	2,351 14 10	1,453 14 8	4,328 11 4	19 6	813 14 9	897 6 5	6,039 12 6	27 2	2,000 9 0	9 0	....	4,039 3 6
Mt. Ida	210	71 12 6	253 0 3	110 13 7	435 6 4	41 5	61 8 5	50 4 8	546 19 5	52 1	120 10 0	11 6	....	426 9 5
Norseman	2,209	322 14 7	1,851 6 0	935 12 0	3,109 12 7	28 2	671 9 10	438 19 7	4,220 2 0	38 3	1,034 18 3	9 4	....	3,185 3 9
Ora Banda	1,694½	152 11 3	1,049 15 0	662 16 11	1,865 3 2	20 3	459 6 5	227 17 8	2,552 7 3	30 1	849 2 3	10 0	....	1,703 5 0
Paynes Find	1,065½	223 9 2	1,273 1 8	206 1 8	1,702 12 6	31 11	323 16 2	203 15 1	2,230 3 9	41 10	726 9 7	13 8	....	1,503 14 2
Peak Hill	1,347½	41 9 3	1,211 1 3	419 13 0	1,672 3 6	24 10	166 4 11	268 9 9	2,106 18 2	31 3	677 5 2	10 0	....	1,429 13 0
Sandstone	375	91 4 8	454 10 8	123 4 2	668 19 6	35 8	65 16 5	192 4 0	926 19 11	49 5	210 2 4	11 3	....	716 17 7
Twenty Mile Sandy	....	....	....	....	....	....	25 11 11	2 0 0	27 11 11	....	....	....	....	27 11 11
Wiluna	2,092½	140 15 11	1,211 10 1	398 17 5	1,751 3 5	16 9	707 13 3	526 2 1	2,984 18 9	28 6	1,040 1 2	9 11	....	1,944 17 7
Yarri	2,291	321 3 8	2,066 13 8	534 2 6	2,921 19 10	25 6	248 18 11	570 14 0	3,741 12 9	32 8	1,188 10 9	10 4	....	2,553 2 0
Lake Darlot	....	....	....	....	....	....	....	....	....	....	2 10 0	....	2 10 0	....
	51,079½	4,853 15 8	28,704 5 2	13,558 8 10	47,116 9 8	18 5	7,150 14 1	8,777 19 0	63,045 2 9	24 8	24,923 2 7	9 9	62 12 6	38,184 12 8
TOTAL LOSS	....	....	....	....	....	....	....	....	....	....	....	....	....	38,122 0 2

* Tonnage for costing purposes.

SCHEDULE No. 5.

Statement of Receipts and Expenditure for Year ended 31st December, 1950.

TAILING TREATMENT.

Batteries.	Tons Treated.	Expenditure.									Receipts.		Profit.	Loss.
		Management.	Wages.	Stores.	Total Working Expenditure.	Cost per Ton.	Repairs and Renewals.	Sundries.	Gross Expenditure.	Cost per Ton.	Receipts.	Receipts per Ton.		
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.
Bamboo Creek	1,400	168 18 7	736 4 9	492 13 5	1,397 16 9	19 11	42 1 3	223 2 9	1,663 0 9	23 9	1,687 18 5	24 1	24 17 8	....
Boogardie	....	....	....	15 5 10	15 5 10	....	....	....	15 5 10	....	....	....	....	15 5 10
Coolgardie	6,174	383 18 6	2,901 6 6	1,890 19 1	5,176 4 1	16 9	240 16 1	798 19 6	6,215 19 8	20 2	7,245 5 7	23 5	1,029 5 11	....
Cue	4,313	269 3 2	1,728 18 5	1,207 9 2	3,205 10 9	14 10	398 4 0	558 5 3	4,162 0 0	19 4	6,233 2 8	28 11	2,071 2 8	....
Kalgoorlie	10,270	560 4 3	3,764 16 6	2,302 16 7	6,627 17 4	12 11	167 19 4	1,146 14 1	7,942 10 9	15 5	12,654 7 10	24 8	4,711 17 1	....
Laverton	6,104	368 5 3	2,278 13 8	1,153 17 1	3,800 16 0	12 5	446 13 7	766 5 3	5,013 14 10	16 5	9,672 8 6	31 8	4,658 13 8	....
Marble Bar	....	30 4 9	....	36 11 3	66 16 0	....	36 8 0	14 15 10	117 19 10	....	....	....	....	117 19 10
Marvel Loch	....	....	....	25 13 10	25 13 10	....	....	6 1 6	31 15 4	....	....	....	....	31 15 4
Meekatharra	4,086	320 9 1	2,227 15 5	1,327 6 0	3,875 10 6	18 11	93 17 11	1,297 10 7	5,266 19 0	25 9	4,511 7 0	22 1	....	755 12 0
Norseman	4,760	345 2 3	2,352 5 2	1,283 5 2	3,980 12 7	16 9	169 19 8	506 2 2	4,656 14 5	19 7	4,436 16 4	18 8	....	219 18 1
Ora Banda	2,410	302 12 3	1,099 19 6	860 6 11	2,262 18 8	18 9	201 3 1	307 18 5	2,772 0 2	23 0	4,996 18 7	41 6	2,224 18 5	....
Paynes Find	....	....	....	2 14 6	2 14 6	....	....	10 9	3 5 3	....	....	....	....	3 5 3
Peak Hill	978	31 17 4	425 10 6	330 11 5	787 19 3	16 1	490 17 9	311 15 5	1,590 12 5	32 6	880 4 3	18 0	....	710 8 2
Sandstone	....	....	....	12 17 9	12 17 9	....	....	....	12 17 9	....	....	....	....	12 17 9
Wiluna	2,912	33 16 3	1,339 14 0	620 17 4	1,994 7 7	13 8	151 11 9	372 1 10	2,518 1 2	17 4	3,307 14 10	22 9	789 13 8	....
Yarri	2,436	220 18 0	845 18 11	426 12 0	1,493 8 11	12 3	134 14 5	215 1 7	1,843 4 11	15 1	2,859 2 10	23 6	1,015 17 11	....
Mt. Ida	....	....	....	....	....	....	....	....	....	....	253 8 6	....	253 8 6	....
	45,843	3,035 9 8	19,701 3 4	11,989 17 4	34,726 10 4	15 2	2,574 6 10	6,525 4 11	43,826 2 1	19 1	58,738 15 4	25 7	16,779 15 6	1,867 2 3
Interest Paid to Treasury	....	....	....	....	....	....	....	....	....	....	1,499 1 4	....	....	1,499 1 4
Nett Receipts	....	....	....	....	....	....	....	....	....	....	57,239 14 0	....	....	3,366 3 7
													3,366 3 7	
TOTAL PROFIT	....	....	....	....	....	....	....	....	....	....	....	....	13,413 11 11	....

ANNUAL PROGRESS REPORT OF THE GEOLOGICAL SURVEY BRANCH OF THE MINES DEPARTMENT FOR THE YEAR, 1950.

Contents

List of Plates

List of Figures

Division IV.

Annual Progress Report of the Geological Survey of Western Australia for the Year ended 31st December, 1950.

The Under Secretary for Mines,

I have the honour to submit, for the information of the Honourable the Minister for Mines, my report on the operations and progress of the Geological Survey for the year ended 31st December, 1950.

The work of the Geological Survey was carried out by 11 classified officers consisting of the Government Geologist, 6 geologists and 4 office staff.

Availability of Geologists.

Period.	No. of Geologists available, including Government Geologist.	Area of State.	Square Miles per Geologist.	Population.
1950.		sq. miles. 975,920	....	558,000
Jan.-Feb.	8	....	121,900	....
March	7	....	139,410	....
April-May....	6	....	162,650	....
June-Dec.	7	....	139,410	....

FIELD WORK.

Major Field Work completed during the Year and in Progress as at December, 31

(1) A geological reconnaissance of the Cue-Day Dawn area in which particular attention was paid to the regional structure and the occurrence of gold, was completed.

(2) A systematic search for deposits of ironstone and limestone of commercial grade and size was carried out over an area situated within a 50 mile radius of Bunbury, most of this work was carried out in thickly timbered, hilly country and yielded negative results for a great deal of physical effort. The Department of Industrial Development had assured representatives of Brasserts Ltd., who had been approached in the matter of establishing a steel industry based on Bunbury and using Collie coal and S.W. iron ore and limestone, that there were unlimited resources of both ironstone and limestone of suitable grade for a steel industry. This was done without prior reference to the Geological Survey.

The result of the work done by this Branch in conjunction with analytical work done by the Mineral Section of the Government Chemical Laboratory was that no deposits of iron ore or limestone of suitable grade and size occurred within a radius of 40 miles of Bunbury.

(3) Field work was commenced in August by 5 geologists on a detailed economic geological survey of an area of approximately 2,000 square miles of country surrounding the city of Perth. This is at present in progress and is referred to elsewhere as the geological survey of the Metropolitan Area. The principal aim is the location and valuation of industrial minerals and rocks.

(4) Supervision of deep drilling and shallow percussion drilling on the Collie Coal field.

PUBLICATIONS.

Issued during 1950.

Annual Progress Report of the Geological Survey of Western Australia for 1947.

Bulletin No. 102: The Greenbushes Mineral Field, by R.A. Hobson, B.Sc. (Hons.) and R.S. Matheson, B.Sc.

Bulletin No. 104: Some Economic Aspects of the Principal Tantalum Bearing Deposits of the Pilbara Goldfield, by H. A. Ellis, B.Sc., A.O.S.M.

Bulletin No. 106: A Geological Reconnaissance of Portion of the Yalgoo, Peak Hill and Gascoyne Goldfields, by W. Johnson, B.Sc. (Hons.).

Atlas of Maps to accompany Bulletin No. 101. (Bull. 101 issued 1947.)

In the Press.

Annual Progress Report of the Geological Survey of Western Australia for 1948.

Annual Progress Report of the Geological Survey of Western Australia for 1949.

Bulletin No. 103: Geology of Portion of the Mt. Margaret Goldfield, by R. A. Hobson, B.Sc. (Hons.) and K. R. Miles, D.Sc., with two atlases of maps.

Mineral Resources of Western Australia Bulletin No. 5: Moulding Sands of Western Australia, by K. R. Miles, D.Sc. and H. A. Stephens, B.Sc.

Bulletin No. 95 (1st Reprint): The Physiography of Western Australia, by J. T. Jutson, B.Sc., LL.B.

Geological Sketch Map of Western Australia, Scale 40 miles=1 inch.

Compiled and Awaiting Authority to Print.

Bulletin No. 107: A Re-Survey of the Coolgardie District, W.A., by J. C. McMath, B.Sc. (Hons. Lond.), F.G.S., M.Aust.I.M.M. and N. M. Gray, B.Sc.

Mineral Resources of Western Australia Bulletin No. 6: Silver, Lead and Zinc, by W. Johnson, B.Sc. (Hons.).

Mineral Resources of Western Australia Bulletin No. 7: Vermiculite, Talc and Soapstone, Fuller's Earth, Bentonite, and Diatomite, by W. Johnson, B.Sc. (Hons.).

Bulletin No. 108: The Geology of the Irwin River and Eradu Coal Basins, by W. Johnson, B.Sc. (Hons.), J. S. Gleeson, B.Sc. and L. E. de la Hunty, B.Sc.

In Course of Preparation.

Bulletin No. 105: The Collie Mineral Field, Part I, by J. H. Lord, B.Sc., F.G.S.

A large amount of field and office work has been done during the year, and my thanks are due to those responsible for a satisfactory combined effort.

H. A. ELLIS,
Government Geologist.

January, 25, 1951.

REPORT ON DOMESTIC WATER SUPPLY "TIMONI" GOLD MINE. MT. IDA. NORTH COOLGARDIE G. F.

By H. A. Ellis, B.Sc., A.O.S.M., Government Geologist.

Locality.

The "Timoni" Gold Mine is situated 62 miles by road north-west of Menzies. It is the only operating mine in the district and is owned and operated by Goldfields Australian Development Coy. Ltd., of 39 Boulder Road, Kalgoorlie. The inspection on which this report is based was made on May 15, 1950.

Development.

During the last three years the company has spent approximately £250,000 in mine development, treatment plant erection, and housing. The mine is fully developed to a depth of 600 feet, and has proved ore reserves sufficient to keep the mill operating for seven years as from May 1950.

The last level driven, No. 6, at a vertical depth of 600 feet, is the best level in the mine, and the future prospects in depth are very good.

Population.

Population as at May 1950 consisted of 150 persons all told, living in mine-owned houses and huts on the company's leases. There is no recognised township established yet. It is estimated that soon this number will be increased to 200.

Present Sources of Water Supply.

(a) Treatment water.

Water for milling purposes will be obtained from mine workings.

(b) Ablution water—mine showers.

Mine water is not suitable, and water has to be carted for this purpose.

(c) Domestic water.

This is obtained from two sources.

1. Rain water tanks attached to buildings.
2. Carted from well supplies over distances up to five miles.

The Immediate Water Supply Problem. Treatment Water.

In 1948 the Geological Survey examined the mine, and among other things made recommendations aimed at ensuring the best exploration for further supplies of underground water from sources within the area being developed by the company at present.

No immediate problem exists with regard to this type of supply. (May 1950.)

Domestic Water.

At present (May 1950) the company is carting 20,000 gallons per week from two sources, viz., the Government well on water reserve No. 12922, situated about 1¼ miles north of the mine, and from the tank at the Mt. Ida State Battery under a "Gentleman's agreement" with the lessee of the battery, Mr. A. E. Grey. The company provides petrol for the engine operating the State Battery pumping plant on their well located about 1½ miles north-east of the battery on water reserve No. 12353, and in return is permitted to draw water from the battery tank.

The overall consumption of water for mine ablution and domestic purposes averages around 19 gallons per head per day. This is not a generous allowance, and does not permit of the use of water on gardens or lawns, which naturally do not exist at Mt. Ida at present.

The capacity of the Government well on reserve No. 12922 situated about 1¼ miles north of the mine is about 4,000 gallons per day. That of the well supplying the State Battery tanks is reported to be 19,000 gallons per day.

The company has tested all existing old wells within a radius of eight miles of the mine and finds that the maximum yield of any one of them is 1,000 gallons per day.

The only existing reliable sources of supply then are those mentioned above, and they cannot be controlled by the company because they are Government property. In any case these two sources can supply only the bare domestic needs of the existing population, and make no provision for what could be called "amenity water," i.e., water for gardens and lawns, so necessary in this part of the country.

Prospects of Obtaining Additional Supplies of Domestic Water.

Usable ground water could occur in three different types of geological structures in the Mt. Ida district, all confined to the granitic terrain north and north-east of the mine. The greenstone country will not provide potable ground water. These structures are:—

(a) In decomposed granite in or close to the margins of existing drainage channels, e.g., the Government well 1¼ miles north-of the mine. This class of structure has only a very thin development of alluvium which is not important as an aquifer.

(b) In drainage channels in which there is a thick development of alluvium overlying decomposed granite, e.g., Sharman's well, situated approximately four miles by track north of the mine.

(c) In wide alluviated basins or flats in which there is no defined drainage system, e.g., the Government State Battery well on water reserve No. 12352 situated about eight miles north-east of the mine.

The immediate problem is to locate a source of underground water suitable for development as a permanent supply in reliable quantities by means of wells and a pipe line to the mine area.

Wells located in structures similar to (a) above have no prospect of yielding large quantities of underground water. We are not so much concerned with finding water; bores almost anywhere in the granitic terrain except on solid outcrop granite, will yield some water. We are concerned with quantity and quality, and the other two classes of structures (b) and (c) are the types capable of holding and yielding large amounts of water.

In Sharman's well there is about 50 feet of rather poorly sorted alluvium overlying a very decomposed kaolinised granite. The alluvium did not contain water—the decomposed granite below the alluvium yielded about 1,000 gallons per day.

The well is in a wide, flat, irregular drainage channel which has been filled with alluvium. What is the maximum depth of this alluvium, and where is its deepest point? This apparently flat area overlies a buried stream bed, and in its deepest part this alluvium could contain large quantities of water.

A series of exploratory bores across this alluviated area would adequately answer the questions raised above. Bores should be sunk to hard granite.

The other type of favourable structure, (c), has been exploited in the well on reserve No. 12352 from which the State Battery draws its water, and undoubtedly other wells of similar capacity could be located in this area.

This favourable locality is eight miles away and it is thought that another and closer area situated about 1½ miles north of Mt. Ida Townsite may have the characteristics of an alluviated basin. This locality is perhaps the best prospect and should be the first one prospected by bores to solid granite.

A pipe line about four miles long would be needed to bring the water from either the Sharman well locality or from this locality to the mine area, should either area prove satisfactory.

Failing the successful development of either of these localities then the area in the vicinity of the State Battery well—reserve No. 12352—would have to be relied upon to provide the necessary quantity of water. This would mean at least eight miles of pipe line unless arrangements could be made to use the existing 1¾ miles of pipe line from the State Battery well to the State Battery tank at the State Battery, when over six miles of pipe line would have to be provided by the company.

Arrangements for Exploratory Drilling.

The writer visited the Mt. Ida district and conferred with the local mine manager at the mine and with the general manager of the company in Kalgoorlie.

It was learned that a contract had been let by the company to a drilling contractor from the wheat belt, to undertake the exploratory drilling at a price of £1 per foot. The contractor demanded a guaranteed minimum footage of 1,000 feet, so that should the first hole drilled be successful then it would cost the company £1,000. A depth of 150 feet is likely to be the maximum depth of any drill hole in this district.

The likely areas were examined with the mine manager, and further reconnaissance examinations were made by the writer alone. The geological problems and the best methods of attacking the water supply problem were discussed with and outlined to the mine manager.

The company is now in a position to go ahead with the water-boring exploration, and intends to do so.

The writer was asked, rather naturally, he thought, whether the Goldfields Water Supply Branch of the Public Works Department would be willing to help the company in its water supply problems. Subsequent inquiry by the writer from the Engineer in Charge, Goldfields Water Supply Department, indicates that this Branch of the Public Works Department regards it as the function of the mine to provide water for its employees, and that it is not interested in this particular problem.

A RECONNAISSANCE SURVEY OF THE CUE AND DAY DAWN DISTRICTS, MURCHISON GOLDFIELD, W.A.

By J. C. McMath, B.Sc. (Hons. Lond.), F.G.S., M.A.I.M.M.

INTRODUCTION.

In the light of regional structural work in the Yilgarn and Coolgardie Goldfields[1] and subsequent recognition of some general relations of gold mineralisation to regional geological structure, a reconnaissance geological survey of approximately 600 square miles in the Cue District (Murchison Goldfield) was undertaken between September, 1949, and April, 1950. This region, hereinafter termed the "Area," ranges between Cue Town, on the north, southwards to Moyagee Siding. A glance at the accompanying map will give a rapid appreciation of the detailed boundaries.

A structural appreciation of the Area has been made together with a more detailed stratigraphical picture than has hitherto been available[2]. Unfortunately no clear and unequivocal picture of the relation of gold mineralisation to geological structure was to be had in detail, though broad loci of mineralisation in relation to structure were apparent. It must be borne in mind that detailed large scale mapping and investigation of mining groups would be necessary to amplify the picture now presented—such work could legitimately form an aspect of exploration programmes of mining companies.

General Information.

Location.

Cue (the administrative centre of the Murchison G.F.) lies approximately 400 miles north of Perth and 300 miles east of Geraldton—the nearest port.

Reference Maps.

3 Lands & Surveys Dept. Lithograph 54/300 Topographical Series—10 miles = 1 inch. Geraldton.

Communications.

(a) *Railway.*—Cue lies on the Meekatharra-Wiluna Branch of the Western Australian Government Railways. It is the junction for Big Bell; Geraldton is reached via Mullewa.

(b) *Road.*—Cue lies some 400 miles north of Perth on the Northern Highway and approximately 300 miles east of Geraldton via Mt. Magnet and Yalgoo.

(c) *Air.*—An air service connects Cue with Perth, Geraldton, Kalgoorlie, and points north.

Commonwealth and State Facilities.

(a) *Commonwealth.*—Post and Telegraph Office.

(b) *State.*—Warden and Resident Magistrate's Office, Mining Registrar's Office, State Battery, Inspection of Mines Office, and office of the Goldfields Water Supply.

Other Facilities.

Consist of a branch of the Bank of New South Wales, together with three hotels and modest shopping facilities. There is a hospital, but the nearest doctor is at Big Bell.

Water Supply.

The town has a reticulated water supply drawn from wells at Nallan, 12 miles north. The water is exceedingly hard and saline.

Mining Timber and Fuel.

No useful mining timber is to be had in this "mulga" country—though small prospectors usually contrive to "make do". Wood for fuel is scarce in the vicinity of the town but is available within reasonable range.

Acknowledgements.

No type of survey can be executed without the co-operation of many organisations and individuals. The author is happy to record his indebtedness for diverse assistance rendered by officials of the Mines Department, Goldfields Water Supply, mine owners, prospectors, and many others too numerous for individual acknowledgement.

[1] Bull. 97, G.S.W.A., 1939, H. A. Ellis. Bull. 107, G.S.W.A. (awaiting publication), J. C. McMath.

[2] Ref. brief bibliography.

[3] Obtainable from Lands and Surveys Department, Perth.

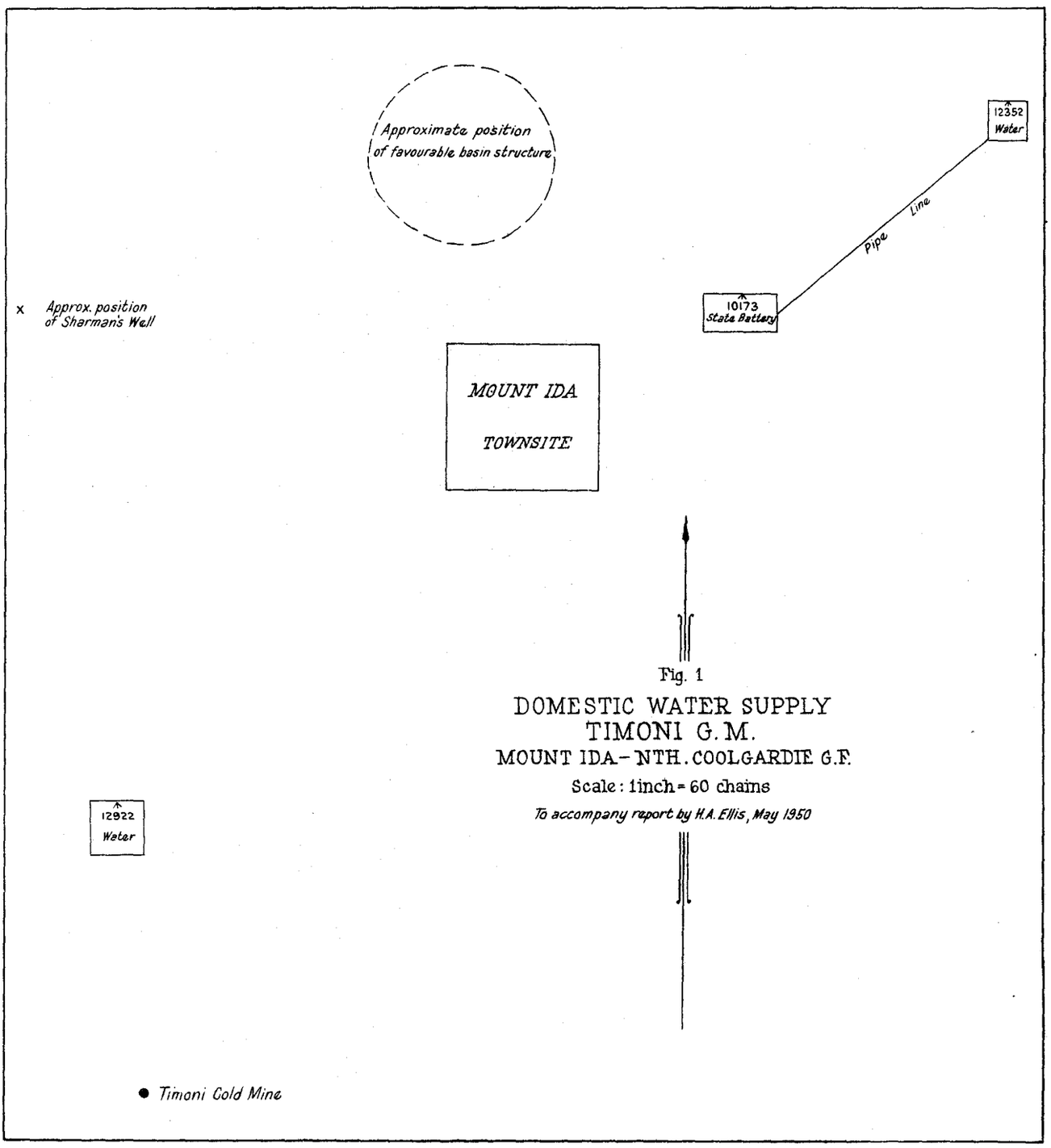


Fig. 1

DOMESTIC WATER SUPPLY
TIMONI G.M.
MOUNT IDA – NTH. COOLGARDIE G.F.

Scale: 1 inch = 60 chains

To accompany report by H.A. Ellis, May 1950

PLATE I

RECONNAISSANCE STRUCTURAL MAP OF THE CUE–DAY DAWN DISTRICT

MURCHISON GOLDFIELD

SHEET 1

Scale : 40 chains = 1 inch

40 20 0 40 80 100

Geology by J.C. McMath, B.Sc., F.G.S. 1949 – 1950

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

LEGEND

- Laterite
- Alluvium
- Soil-covered areas { The nature of the underlying rocks cannot be inferred with any degree of certainty }

PRE-CAMBRIAN

METAMORPHOSED SEDIMENTS (Pre-Cygnian Group)
- Metamorphosed sediments { Consisting of slates, phyllites, mica schists, thin bands of greenstone with a developments of acid porphyritic lavas } — Metamorphosed sediments; Acid porphyritic lavas

Relationship obscure

GREENSTONE ASSETS (Pre-Cygnian Group)
- Metamorphosed basic lavas { Fine to medium grained basic lavas, amygdaloidal and pillow lavas and thin slates (probably metamorphosed tuffs) }
- Metagabbro { Medium to coarse grained hornblende and hornblende – felspar rocks (minor intrusives) }

Relationship obscure

SEDIMENTARY ASSETS (Pre-Cygnian Group)
- Metamorphosed sediments { Dominant type Jaspilite, mica schists thin bands of greenstone } — Jaspilite
- Slates

Granite, Granite-gneiss and allied rocks

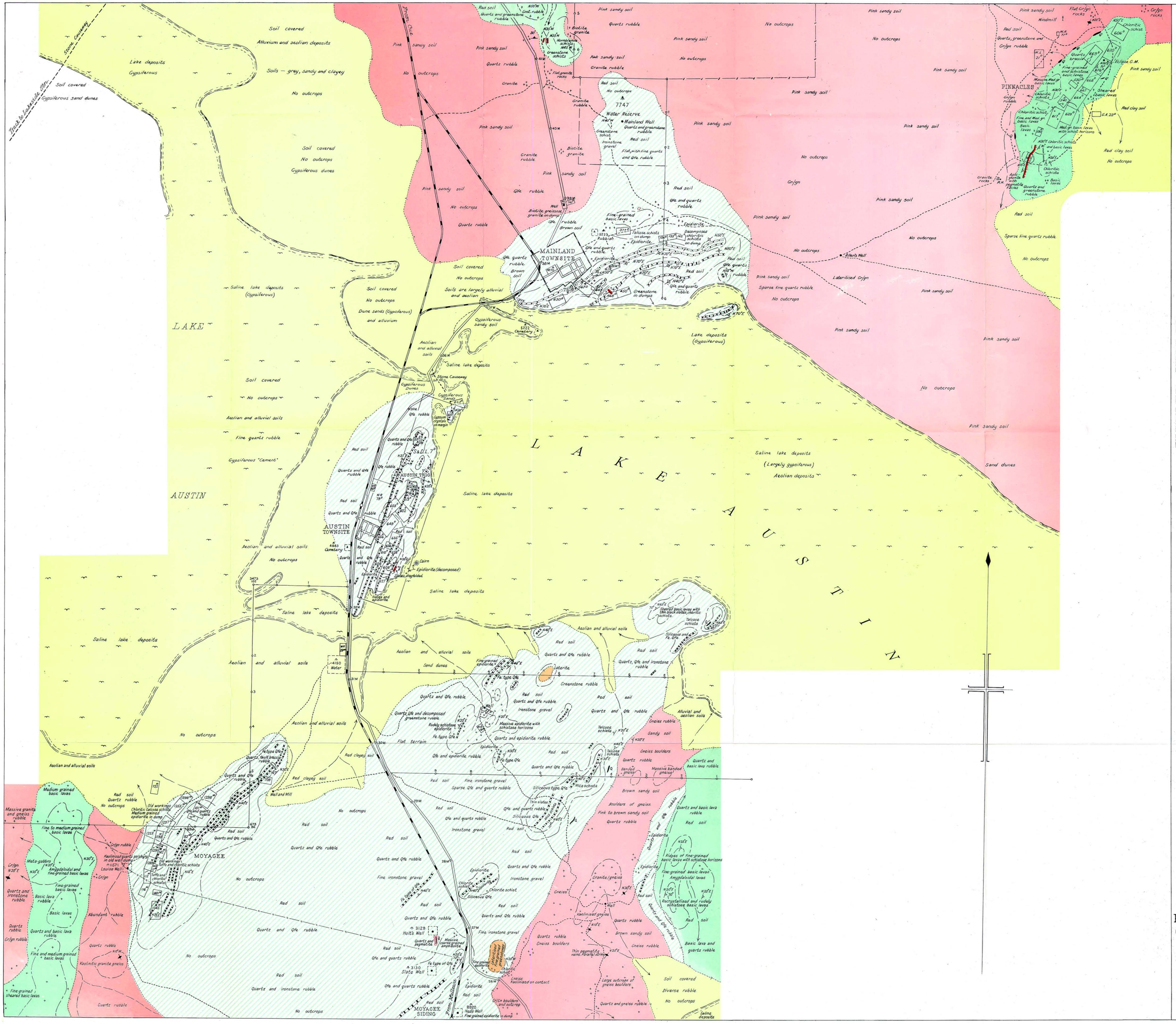
Acid porphyritic minor intrusives

Quartz reefs

REFERENCE TO SIGNS

- Observed geological boundary
- Approximate geological boundary
- Assumed geological boundary
- Faults
- Strike and dip of schistosity (N10°E, 70°)
- Strike of vertical schistosity (N10°E)
- Strike of schistosity with no observed dip (N15°E)
- Strike and dip of bedding (N15°E, 60°)
- Strike and dip of foliation (N20°W, 60°)
- Strike of vertical foliation (N30°W)
- Outcrops with no observed strike or dip
- Form lines
- Bluffs and breakaways
- Watercourses (Normally dry)
- Wells
- Fences
- Tracks
- Railways

PLATE I



LEGEND

- Laterite
- Alluvium
- Soil-covered areas { The nature of the underlying rocks cannot be inferred with any degree of certainty }

PRE-CAMBRIAN

Relationship obscure

GREENSTONE SERIES (Pre-tightening folding)
- Metamorphosed basic lavas { Fine to medium grained basic lavas, amygdaloidal and pillow lavas and chlorite slates (probably metamorphosed tuffs) }
- Metagabbro { Medium to coarse grained hornblende and hornblende - felspar rocks (minor intrusives) }

Relationship obscure

GREENSTONE? SERIES (Pre-tightening folding)
- Metamorphosed sediments { Dominant type Jaspillite, mica schists, thin bands of greenstone }
- Slates

- Granite, Granite-gneiss and allied rocks
- Acid porphyritic minor intrusives
- Quartz reefs

REFERENCE TO SIGNS

- Observed geological boundary
- Approximate geological boundary
- Assumed geological boundary
- Faults
- Strike and dip of schistosity
- Strike of vertical schistosity
- Strike of schistosity with no observed dip
- Strike and dip of bedding
- Strike and dip of foliation
- Strike of vertical foliation
- Outcrops with no observed strike or dip
- Strike and plunge of dragfold
- Rock Hole
- Watercourses (Normally dry)
- Wells
- Fences
- Tracks
- Railways
- Form lines
- Bluffs and breakaways

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

RECONNAISSANCE STRUCTURAL MAP OF THE CUE-DAY DAWN DISTRICT

MURCHISON GOLDFIELD

SHEET 2

Scale : 40 chains = 1 inch

40 20 0 40 80 120

Geology by J.C. McMath, B.Sc., F.G.S. 1949 — 1950.

Mining Activity and Production Statistics.

Cue is one of the oldest mining centres in the State, owing its discovery to—and taking its name from—Tom Cue who found alluvial gold in 1891 on an area subsequently known as "The Patch". "The Patch" lies on the northern boundary of the present town.

By 1893 the character of the gold winning had changed from that of alluvial diggings to that of "hard rock" mining.

With the exception of the well known Great Fingall Mine (shut down shortly after World War I), the general history of the area is one of small and short lived ventures. The Great Fingall Mine was originally known as the Day Dawn (discovered in 1891) from which the town takes its name.

At the time of writing (1950) prospecting is virtually moribund with the exception of the drilling operations of the Great Fingall Exploration Company who are carrying out deep prospecting operations for a possible repetition in depth of the Great Fingall orebody. Within the area surveyed mining is mainly limited to "gouging" of old shows, the major exception being the Mountain View Mine at Day Dawn.

Total production of the area to the end of 1949 is as under:—

District.	Ore Treated.	Gold Therefrom.	Average Grade.
	long tons.	fine ozs.	dwts.
Cue	4,843,754·24	1,121,047·1	4·6
Day Dawn....	2,025,932·63	1,369,391·73	13·5
Totals	6,869,686·87	2,490,438·83	7·3

Brief Bibliography.

Bull. No 7, G.S.W.A.—1903—Auriferous Reefs of Cue and Day Dawn—W. D. Campbell.

Bull. No. 8, G.S.W.A.—1903—Murchison Goldfield—C. G. Gibson.

Bull. No. 29, G.S.W.A.—1907—A report upon the Geology, together with a description of the Productive Mines of the Cue and Day Dawn Districts, Murchison G.F. Pt. I.—H. P. Woodward.

Annual Report, G.S.W.A. 1906—Day Dawn and Cuddingwarra —H. P. Woodward.

Annual Report, G.S.W.A. 1898—Cue and Lake Way Traverse—T. Blatchford.

Mining Handbook, 1919—Cue and Day Dawn Gold Deposits—A. G. Maitland.

GEOLOGICAL NOTES.

Introduction.

The Area consists, in the main, of Pre-Cambrian folded rocks together with granites, granite-gneisses (largely the product of "granitisation" processes be what they may) and some younger basic intrusives. Apart from detailed mining investigations and some diamond drilling of certain leases[4] geological work has been confined to the broad general work carried out in the early years of this century. This work was, of necessity, incomplete (as is also the present work), yielding only the very general stratigraphic outline and but little conception of regional structure. It was to expand this knowledge in terms of current structural and stratigraphic advances, correlating these aspects with gold mineralisation (if possible) that the present work was undertaken.

Geomorphology.

The Area lies on the north-western boundary of "Salina-land"[5] and is, with its general mulga scrub vegetation, alluviated and eluviated terrains (comprising some 60 per cent. to 70 per cent. of the Area), isolated ridges of Pre-Cambrian rocks, "breakways," and "dry" lakes (Lake Austin and its ramifications), quite typical of this physiographic division.

Major Positive Relief Elements consists of the following:—

(i) Sharp (almost knife-edged) ridges of steeply dipping jaspilites which occupy the Area south of, and including, Mainland.

(ii) Equally high, but more rounded and dissected, ridges of "Greenstones" as at Cue, Day Dawn, Cuddingwarra, and on the east and west flanks of the jaspilites at Moyagee in the south of the Area.

(iii) The occasional granite "rocks"—as in the "Garden Granites" to the east of Cue on the Sandstone road.

(iv) The "breakways," mesas, and buttes of "granitised" greenstones, granite-gneiss, etc. which form so prominent a part of the topography on the north side of the town. (Bull. 95—G.S.W.A. 1934—pages 234, 238 give good illustrations of these features).

These features have a general accordancy of summits (though they are dominated by Trenton Hill (approx. 1,620 ft. a.s.l.) and Cue Hill (approx. 1.653 ft. a.s.l.) and form part of the "Old Plateau" of Western Australia[6].

Minor Positive Relief Elements consist of the following:—

(i) Low rounded hills, rising very little above the general level, which largely consist of schistose greenstones or basic meta-sedimentary rocks. These are usually lateritised to lesser or greater degree. The country to the east of Cue and adjacent to the railway is typical as also are some localities between Day Dawn and Cuddingwarra.

(ii) Occasional igneous intrusives of dyke form —e.g. the syenitic dyke intruded into the flat terrain of Pinnacles granite gneiss— which are so prominent in eluviated and alluviated landscapes. Quartz "blows," such as those to be seen north of the town, come into this category.

(iii) "Island" residuals of dolertic intrusives usually taking a conical form) which rise above the alluvium as in Lake Austin and at Cuddingwarra to the north of the Big Bell railway spur line. These features are also well illustrated in the Bulletin previously cited.

(iv) Sand dunes, vegetated and, otherwise about Lake Austin.

These features form intermediate steps between the "Old" Plateau and the "New" Plateau of the present cycle of erosion.

Negative Relief Elements consists of the following:—

(i) The "dry" or "salt" Lake Austin and its ramifications.

(ii) Wide flat alluviated and eluviated valleys —e.g. the country between Day Dawn and Cuddingwarra (especially about Austin Downs Homestead). These flat terrains may show pavements of granite-gneiss or meta-sedimentary rocks.

These features constitute the "New" Plateau under construction in the present cycle of erosion.

Drainage.

Drainage within the Area is internal, the focus being Lake Austin, and ephemeral. Creeks, with few exceptions debouch upon alluviated flats although all drainage ultimately finds its ways to the Lake; sheet flooding and sheet erosion are features. Few well defined drainage courses are to be found, although two major ones exist:—

(a) That which drains from Cue past Day Dawn to Lake Austin.

[4] Bull. 48, G.S.W.A., 1912, H. P. Woodward.

[5] Bull. 95, G.S.W.A., 1934, J. T. Jutson.

[6] J. T. JUTSON, op. cit.

(b) The "Water Supply River" which drains from Cue to Lake Austin on the western side of the Trenton group of hills.

Otherwise drainage channels are better thought of as "trends."

Reference to the accompanying map shows that a very large measure of structural control is evident in the drainage pattern. This control is thought to be largely posthumous. Lake Austin, which might represent an original depression on an uplifted surface, shows in its ramifications a certain parallelism to regional structures. The main body of the lake, however, cuts across these structures at a large angle. The question of origin remains open.

The sand dunes about Lake Austin remain for comment.

Two types are distinguished:—

(a) Yellow, fine grained, non-vegetated, gypsiferous dunes. These may carry a cap of gypsum bearing sandstone and, owing to proximity to road and railway, may be of future economic interest. They are Recent in age.

(b) Fine grained, red to purple, vegetated dunes which are relics of a previous erosion cycle.

The Folded Pre-Cambrian Rocks.

Within the Area are rocks which have undergone folding on a regional scale, subsequent igneous intrusion, and "granitisation" in varying degree. The following elements, in their stratigraphic order, are distinguished:—

(a) *Meta-sedimentary* rocks showing jaspilites as their most prominent topographic expression. They carry occasional thin amphibolite schist horizons and have been intruded by minor meta-doleritic rocks (also folded).

(b) *Basic lavas* with very subordinate schistose meta-sedimentary horizons.

(c) *Meta-sedimentary* rocks with developments of acid lavas, occasional thin amphibolite schists.

(d) *Meta-gabbro* and dolerite minor intrusives.

(e) Occasional small quartz-porphyry dykes and/or sills.

The development of the meta-sedimentary rocks with jaspilites is confined to the Moyagee-Austin-Mainland area. The jaspilites comprise the bulk of the outcrop (excepting granitic gneiss). These jaspilites vary from siliceous cherty to ferruginous types; are, in places, highly contorted and drag-folded, and show, in the Moyagee locality, a graduation to granitised equivalents and thence to granitic gneiss which may preserve original structures.

The basic lavas, which are stratagraphically younger than the jaspilitic meta-sediments, may be seen in juxtaposition with them in the Moyagee area. These lavas range in type from fine grained basalts and amygdaloidal lavas to porphyritic and pillow types. The Porphyritic lavas usually have felspar as phenocrysts. Tuffaceous horizons, now slates, occur. As a whole the lavas present a fresh appearance although some re-crystallisation has taken place and the development of chlorite is to be noted in places. These lavas have their maximum occurrence in the Trenton and Cue groups of hills.

Neither base nor top of these two units have been recognised, although the Moyagee granitic gneiss represents in part the lower portion of the jaspilitic meta-sediments. Also, the relation between these meta-sediments and the basic lavas is not to be seen. It may be conformable or unconformable. Paucity of outcrop has necessitated inferred boundaries between the two units.

West of Trenton Hill and ranging as far as Cuddingwarra (and southwards to Lake Austin) are thin quartzites, amphibolitic and mica schists. In the centre of this area is a development of acid lavas, ranging in texture from felsitic to porphyritic. Flow tops are to be seen. From structural evidence these meta-sediments are younger than the basic lavas. Again, due to paucity of outcrop, the relation between these rocks and the basic lavas is nowhere to be seen. It may be conformable or unconformable. Nowhere has either base or top been seen. These rocks furnish but minor topographic elements and are characterised by deep weathering, a tendency to be kaolinised to some depth, and a varying degree of lateritisation.

In the foregoing are gabbroic and doleritic minor intrusives which have also undergone regional folding. Soil cover largely obscures the relations of these two younger meta-sedimentary rocks, It is, however, in the basic lavas that it can best be seen that they have undergone regional folding.

These meta gabbros are medium to coarse and equigranular in texture; they may be blocky or rudely schistose. In mineral composition they vary between approximately equal proportions of amphibole and felspar to a type in which amphibole predominates. The amphibole may be clustered in knots giving a porphyritic look to the rock. Quartz is present in minor amount. Pegmatoid phases have been noted.

The most interesting of these bodies is a sill form, intruded into the basic lavas (in which pillow lavas predominate) of Day Dawn. This body extends from the Strathmore Mine (G.M.L. 592D, abandoned) in the south, northwards through the Trenton Mine (G.M.L. 148D, abandoned) and the Fingall Leases. This sill is intimately connected with the Fingall ore bodies over whose distribution it exercises a structural control. More detailed work should prove of value to the local mining communtity.

Associated with both the jaspilitic meta-sedimentary rocks, the basic lavas, and the Day Dawn-Cuddingwarra meta-sediments are occasional quartz-porphry sills and/or dykes which show the same structures as have been imposed upon the folded rocks. They largely appear to be concordant intrusives and may be seen, for example, in the vicinity of G.M.L. 425D, at Day Dawn. They have not been noted in relation to the later meta-gabbros and dolerites.

Post-Folding Rocks.

Associated with the folded-Pre-Cambrian rocks are major and minor acid igneous intrusives and a few small basic dykes. There is no field evidence as to their mutual relations in time. As far as observable—gold quartz reefs come into this category. These rocks then are:—

(i) *Magmatic granites* (previously referred to) together with minor acid intrusives associated with them. These minor acid intrusives are dominantly quartz-porphyries, though micro-granites occur. In no case was any minor intrusives seen directly as an apophysis of a major granite though their general proximity to granites makes this inference valid, These rocks, on available evidence, are post-folding and post "granitisation" in age.

(ii) *A massively jointed,* coarse and equiangular grained syenitic dyke of approximate east-west trend intruded into the granitic gneiss of the north Pinnacles area. This rock carries very subordinate quartz, and about approximately equal quantities of pyroxene and felspar. There is some secondary amphibole. In age this rock can only be rated as "post-granitisation."

(iii) *Small doleritic dykes,* usually showing chilled margins. These are known from old workings in the hybrid gneissose granite to the west-north-west of Cue, (e.g. G.M.L. 1296). They are post magmatic granite and post gold mineralisation in age.

(iv) *Gold-quartz veins*—these occur in all members of the folded Pre-Cambrian Rocks and in the hybrid gneissose granites; hence they are post-magmatic and pre-dolerite in age.

Recent Deposits.

Some 60% to 70% of the Area is covered by Tertiary-Recent deposits. These deposits comprise:—

(i) *Laterites (incl. "cements").* The broad distribution of laterites is confined to traces of the "Old" and "New" Plateaux of Jutson[7] where they form the spectacular "breakaways," buttes, and mesas to the north of Cue and the "breakaways" bordering Lake Austin in the south-west corner of the area respectively. Thus they are associated with the granitic gneisses and meta-sedimentary rocks respectively and, accordingly, are dominantly alumina and iron rich in type. Of interest is the development of a considerable kaolinitic basal phase, especially in those laterites associated with the Day Dawn-Cuddingwarra meta-sediments. Between the "Old" and "New" Plateaux are to found "cements." These occur on both granitic and greenstone terrains and may be of considerable thickness.

(ii) *Lacustrine Deposits and Alluvium.* The former are confined to Lake Austin and its ramifications. Of very variable thickness, they are heavily saline with calcium sulphate appearing preponderant.

Alluvium is confined to the major drainage trends and ranges between a few inches up to about 30 ft. in maximum thickness.

(iii) *Aeolian Deposits* are of two types—one largely non-vegetated and gypsiferous and the other red to liver coloured and vegetated. Both are associated with Lake Austin. They have been referred to previously.

(iv) *Soils* (residual). Residual soils within the Area rarely achieve a depth of more than 10ft. Their characteristics are dependent upon the nature of the underlying rock. The following main types are distinguished:—

(a) *Brick red* clayey soils derived from basic lavas.

(b) *Red soils,* lighter in colour than the above, associated with argillaceous meta-sedimentary rocks.

(c) *Pink sandy soils* associated with granites and granitic-gneisses.

(d) *Brown to grey soils* associated with the metagabbros and dolerites. These may have a green tinge due to undecomposed amphibole.

(e) *Light yellow-grey* sandy soils associated with quartz porphyries and highly siliceous metasedimentary rocks. Their distribution is limited.

Sequence of Rock Types and Events.

From the foregoing the following sequence of rock types and events is given for the Area. It cannot be regarded as final and must remain open for revision resulting from any future work:—

Age.	Description.	Remarks.
Recent	Soils—lake deposits and sand dunes in part	Various types.
Tertiary to Recent	Alluvial, lake deposits, sand dunes in part	These deposits may be younger or older than the laterites. Probably deposits of both ages occur. The "red" dunes are older than the yellow gypsiferous dunes.

[7] Op. cit.

Age.	Description.	Remarks.
Tertiary	Laterites, ferruginous and otherwise, and "cement" deposits	W.A. laterites are generally rated as of Tertiary age.
	Great Unconformity.	
Pre-Cambrian ? Proterozoic	Doleritic minor intrusives and one syenitic dyke	Beyond being post "granitisation" and granite plutons, their stratigraphic position is unknown.
--------	---------- Igneous Contact -------	
Pre-Cambrian Archeozoic	Small granite plutons —some acid minor intrusives, "Garden" granites, etc.	Granites are biotitic types and may be porphyritic. Acid minor intrusives range from microgranites to quartz-porphyrites. Small pegmatite phases may occur. Period of gold mineralisation. Post "granitisation" and folding.
--------	---------- Igneous Contact. --------	
	Granitic gneisses of Moyagee, Cue, Pinnacles	Period of "granitisation" affecting all folded rocks in some measure.
	Period of Earth Movements.	
	Meta-gabbro and dolerite dykes and sills	May show pegmatoid phases. Have been folded.
--------	-------- Igneous Contact ----------	
	Meta-sediments and acid lavas of Day Dawn - Cuddingwarra area. Quartz porphyry minor intrusives	Lie in synclinorial—younger than basic lavas. Folded rocks.
--------	--- Relationship Unknown. ---------	
	Basic lavas—including pillow, amygdaloidal, porphyritic types. Quartz porphyry minor intrusives	Folded rocks.
	Schistose tuffs	
--------	--- Relationship Unknown ---------	
	Meta-sediments including jaspilites of Austin-Moyagee areas	Folded rocks.
	Granitic gneisses of Moyagee	Represent granitised jaspilitic meta-sediments lower in succession than above.

The sequence of Pre-Cambrian events and rock types of the Area bear considerable resemblance to those of the Yilgarn and Coolgardie Goldfields, but there being as yet no direct evidence of close connection in time (beyond the regional folding) and space with these latter Goldfields, and since such lithologic sequences tend to be common throughout various periods in the Pre-Cambrian terrains elsewhere in the world, it is considered that correlation of these ancient folded and non-folded rocks with those elsewhere is at present premature. Equation by lithological analogy over the distance involved is dangerous, however tempting. The folded rocks may or may not be equivalent to the Yilgarn-Kalgoorlie System.

Metamorphism.

Within the Area all folded Pre-Cambrian rocks have, in greater or lesser degree, been metamorphosed. The following types of metamorphism are recognised:—

(a) Regional Metamorphism.

(b) Metamorphism by "granitisation" processes.

(c) Contact metamorphism.

The above is the observed order of relative magnitude. Chronologically, regionally, regional metamorphism preceded "granitisation". Contact metamorphic effects were seen to be limited in nature

and degree but are associated with both pre- and post-folding minor intrusives.

(a) *Regional Metamorphism* is, generally, of low grade—the effects usually being some re-cystallisation of rocks together with the formation of chlorite. These effects are best seen in the basic lavas and the folded meta-gabbroic rocks which are more resistant to weathering and present a remarkably fresh appearance. No metamorphic "highs", such as are seen in analogous rocks of the Coolgardie District, were noted. The events leading to regional metamorphism have impressed a very constant schistosity (varying but few degrees east and west of north) upon the folded rocks. Such schistosity swings in the vicinity of minor "cross-flexures" (which may ultimately prove to be major drag-folds) as in the locality of G.M.Ls. 652D and 511D in the Day Dawn District.

(b) *Granitisation.*—The fact that solid rocks have been converted to rocks of granitic character is indisputable—it is not proposed to enter into controversy as to processes, effectiveness, or scale of operation. Sufficient body of field evidence exists to demonstrate that complete granitisation of solid rocks in situ may be effected, together with the preservation of pre-existing structures. Reference may be made to the following:—

(i) Granitisation and Associated Processes—A. C. Macgregor and G. Wilson—Geol. Mag. Vol. 76—1939.

(ii) Origin of Granite—Memoir 23—1943—Geological Society of America.

(iii) Evolution of Metamorphic Rocks—Memoir 30—1945—Geological Society of America.

The author regards the problem of granitisation as falling within the province of metamorphic geology.

The following main elements are seen in the Area:—

(i) Granites of undoubtable magmatic origin.

(ii) The granitic gneiss areas.

(iii) The areas of highly kaolinised and quartzose rocks (usually metasediments) which may occupy significant positions with regard to the major structures of the basic lavas and jaspilitic metasediments.

Poor outcrop conditions have necessitated that, in large part, geological boundaries be "inferred" or "approximate". It has not proven possible, for the same reason, to differentiate granites and granitic gneisses in the northern part of the Area. Accordingly they have been mapped as "Granite-Gneiss".

I.—Granites of magmatic origin include the "Garden Granites" to the east of Cue and that exposed at the 393 Mile on the Northern Highway. They are biotitic granites with a dominant potash felspar. Some portions are porphyritic. No clear-cut contacts either with the folded rocks or gneisses were seen. They may be regarded as apices of a sub-jacent body of batholithic dimensions. Exposure of these granites occur both as "rocks" and flat pavements—as also do exposures of the granitic gneisses.

II.—Granite Gneisses occur in both the basic lava and jaspilite horizons of the folded rocks as well as in the Day Dawn-Cuddingwarra metasediments. This location with regard to regional structures is of interest and will receive comment later. The following broad division can be made in the field:—

(a) Those granitic gneisses arising from granitisation of the metasediments in the lower portion of the folded rocks. These are best exposed and examined in the eastern portion of the Moyagee locality; again to the south of the Louise Well (Moyagee); and, in less satisfactory manner, on the northern end of the Pinnacle hills. They consist of banded gneisses, the banding of which may consist of either melanocratic and leucocratic minerals or of leucocratic banding only. These granitic gneisses may be porphyroblastic and show fine pegmatitic developments parallel to the gneissosity or to the jointing. The gneissosity has the regional strike, and many of the structures of the adjacent meta-sedimentary rocks have been preserved. Transition zones between meta-sedimentary rocks and the granitic genisses are apt to be characterised by quartz "blows" as in the east Moyagee area and again at Pinnacles and elsewhere.

In the northern section of the east Moyagee area a very clear transition from meta-sedimentary rocks to granitic gneiss can be seen—the transition is distinguished by the bleaching of the jaspilities and the development of a fine grained saccharoidal texture, finally merging into the granitic gneiss. Such fine grained bleached residuals were noted in the granitic gneiss north of Pinnacles and give the appearance of flat plates of fine grained quartzite.

The structural environment of this broad division, whose major development is around Moyagee, is as follows:—

(a) *East Moyagee*—in core of regional anticlinorial.

(b) *West Moyagee*—in a metasedimentary horizon on the western limb of the abovementioned structure. Southwards towards Wandari and Mt. Magnet the terrain is occupied by granitic gneisses in which small residuals of regionally trending jaspilites have been noted.

III.—Granitic gneisses arising from granitisation of the basic lava component of the folded rocks. These are particularly in evidence to the north of Cue where the process may be seen along a fairly sharply defined transition zone in the vicinity of G.M.L. 809.

These rocks give the appearance of being coarse grained and gneissose hornblende granites. They constitute the "gneissic granites" of the older writers.

Along the transition zone between basic lavas and this amphibole granitic gneiss the following phenomena have been noted:—

(a) Granitisation qua granitisation in the vicinity of G.M.L. 809. This has received mention.

(b) Westwards, through Cue toward Cuddingwarra, the process seems to have become magmatically active and the coarse grained gneissose granite carries basic lava xenoliths in varying stages of digestion. This is particularly evident from material from mine dumps in the area.

(c) Northwards from Cue these gneissose granites tend to become finer in grain; amphibole may diminish almost to zero; biotite may become more prominent except in the vicinity of large relicts of basic lavas remaining unassimilated. These relicts have, in the past, been regarded as later intrusions. They are exposed in mines, now inaccessible, such as the Light of Asia and the dumps thereof. Later basic intrusions do, however, occur, e.g. that of G.M.L. 1296, but chilled margins occur.

IV.—Certain horizons, largely tuffaceous and meta-sedimentary, of the basic lavas—e.g. those to the east and west of Day

Dawn—show a tendency to be kaolinised to considerable depth. Such kaolinisation may be associated with lateritisation but the vertical distribution of this tendency suggests that it may coincide with a vertical limit of granitisation and that this latter process has impressed upon the rocks a pre-disposition to weathering of this type. This is purely speculative and the question must, for the present, remain open.

Granitisation is intimately bound up in space and time with regional metamorphism and with what is regarded as normal igneous activity, and it is difficult to consider these effects as divorced and unrelated phenomena. Of the scale of granitisation within the Area—it is remarked that the granitic gneiss greatly predominates in area over the intrusive granites.

The sequence, if sequence it be, of what may be termed "igneometamorphic" events appears to be:—

I. Granitisation affecting both basic lavas and metasediments—the effects being apparently at a minimum, as far as observed, in the Day Dawn-Cuddingwarra metasediments—i.e., there appears to be an upper or vertical limit.

II. Magmatic phase during which granitic magma (? mobile phase of granitisation) has intruded granitised rocks (the granitic gneisses in the Mainland and Garden Granite localities) and basic lavas, assimilating the latter in part.

Current "granitisation" thought as exemplified by Read and Reynolds[8] requires a "basic front". Where is—or what has become of—this "front" within the Area?

The distribution of the granitic gneisses within the Area does not seem entirely fortuitous. The core of the broad regional anticlinorial structure from Moyagee northwards to Cue is occupied by these rocks—which also breach (replace?) the eastern limb in part. A suspected major anticlinorial cross flexure, whose axial zone is about Nallan, is almost entirely represented by gneisses, though the Day Dawn-Cuddingwarra metasediments together with younger doleritic and gabbroidal intrusives are to be seen a mile or two north of the Big Bell road between Cue and Cuddingwarra.

In relation to adjacent territory to the west, the Area shows the same broad igneous and metamorphic features. The recent work of Messrs. Hobson and Johnson[9] has effectively demonstrated the existence of a major batholithic body fringed by granitic gneisses and residuals of folded Pre-Cambrian rocks. The rocks of the Area form portion of the fringe on the eastern flank of this batholith which presents many of the features of the "mantled gneiss domes" of Eskola.[10]

Regional Structure.

Regional folding has affected the older Pre-Cambrian rocks of the Area—the jaspilite, basic lava, and younger metasedimentary series.

Elucidation of the broad structure hinges upon the distribution and attitudes of:—

(a) The jaspilitic series of meta-sediments.

(b) The basic lavas series.

The jaspilitic series are confined to the area south of Mainland whilst the basic lavas occur to the north and extend as far as Cue. They also have a minor development in the Moyagee area.

The jaspilitic series of Mainland and Moyagee demonstrate an anticlinorial structure whose axial zone (which is occupied by replacement gneiss) trends approximately north-south. Of this structure only the western limb and nose (comprised of the Mainland jaspilites) is complete. The eastern limb consists of the east Moyagee jaspilites which are flanked by basic lavas on the east. Southwards the structure becomes lost in the replacement gneiss, though the western limb may be traced as small pendants of jaspilite in the gneiss for some seven miles southwards. From drag-folding in the jaspilites the structure has a steep northerly plunge. Briefly, south of Mainland an anticlinorial structure, with a steep northerly plunge, exists. On both limbs it is flanked by basic lavas, and its axial zone, together with a horizon on the western limb, have been granitised. No evidence of isoclinal or overturned folds was seen—evidence from elsewhere in the area suggests that subsidiary folding may be relatively gentle. Minor structures may sometimes be seen preserved in the replacement gneiss.

Northwards from Mainland the outcrops of the Day Dawn and Cue basic lavas conform in symmetry with the Moyagee anticlinorium. Consideration of bedding-schistosity relations, regional schist dips and strikes, together with pillow lava facings (not clear-cut) point to these lavas being part of the Moyagee anticlinorium. As in the latter structure, the basic lavas present a reasonably complete western limb and nose, whilst the eastern limb is only represented by the Pinnacles basic lava pendant—the remainder of the structure being lost in replacement gneiss. The same steep northerly plunge is evident. Again, the axial zone between Mainland and Cue is occupied by replacement gneiss. Until evidence to the contrary is forthcoming the jaspilite metasediments and the basic lavas are regarded as integral parts of the same north plunging anticlinorium. A problem of scale of development of this portion of the Pre-Cambrian arises since there is a gap, occupied by gneisses, of some ten miles between the nose of jaspilites at Mainland and that of basic lavas at Cue. This gap would represent the disappearance of some 50,000ft. of lavas and sediments. How much of this thickness is due to repetition by internal folding of the anticlinorium? Or, despite general evidence, are the jaspilites and basic lavas portions of different structures? The general stratigraphic relations do not support this possibility—but it remains a possibility, even if remote.

Symmetry considerations of this anticlinorial structure would demand a complementary synclinorium in the Day Dawn-Cuddingwarra area. The basic lavas of Cuddingwarra and Day Dawn together with the meta-sedimentary rocks in between show in their bedding and schistosity relations, pillow lava facings, and general schist dip and strike detail, that the area is synclinorial. Of interest is that some meta-sediments on the shores of Lake Austin in the south-west of the Area show bedding with a northerly dip of 30°.

"Cross-folding" as seen in the Yilgarn and Coolgardie Goldfields, is not apparent in the Area. In the vicinity of the Creme-d'Or Mine and Great Fingall (Day Dawn) there is a suggestion of a "cross-flexure," which could be a major drag-fold on the western limb of the anticlinorium. It is of interest in relation to the Fingall ore bodies.

Rapid, reconnaissance northwards of Cue to Tuckanarra suggests that what can now be called the "Cue Anticlinorium" may be reflected in this locality. Should this prove to be the case, then the Nallan greenstones may mark a "cross-fold" axial zone. Further work is necessary to prove or disprove this suggestion. A detailed study of the following in this possible "cross-fold" zone might prove of economic interest:—

(a) The broad structural venue of gold deposition at Tuckanarra.

(b) The broad structural venue of the above compared with the Cue structure.

(c) The relation of this possible "cross-fold" to the Big Bell gold deposition.

Gold Mineralisation and Regional Structure.

Within the Area gold deposition takes the form of auriferous quartz reefs and lodes. Both modes may occur separately or in association. "No quartz, no gold," as in the Yilgarn and Coolgardie Goldfields, was found to be applicable.

[8] D. L. REYNOLDS, Q.J.G.S., Vol. CII, Pt. 3, 1946.

[9] A.P.R., G.S.W.A., 1948, "Progress Report on the Geology of portion of the North-West Division"—W. Johnson.

[10] "The Problem of Mantled Gneiss Domes," P. E. Eskola (Q.J.G.S., Vol. CIV—1949.).

The distribution of past and present mining leases which have a production record, shows that the major occurrences of gold are largely confined to the Cue anticlinorial structure. Within this major structure further restrictions are noted:—

(i) Major concentration of ore bodies is confined to the nose and western limb of the structure.

(ii) Ore bodies decline in number, size, and grade southwards along the western limb.

(iii) Significant gold mineralisation is confined to:—

(a) the jaspilitic meta-sediments of the Mainland-Moyagee locality;

(b) the meta-sedimentary horizons underlying the basic lavas in the Cue-Day Dawn area;

(c) the granitic gneisses (granitised folded rocks) with associated unassimilated relicts of basic lavas and younger folded meta-dolerites which occur immediately to the north of the north plunging nose at Cue. In the distribution and attitude of these ore bodies there is no suggestion that they favour a stratigraphic horizon now granitised, but rather that they result from control of mineralisation by shears developed in the anticlinorial nose and parallele to the axis thereof;

(d) the margin of the folded meta-gabbro sill at Day-Dawn.

(iv) Significant gold deposition on the eastern limb is confined to the basic lavas of the Pinnacles where it is associated with minor acid intrusives with lode material as the dominant mode of occurrence. At the Moyagee end of this limb, no ore bodies have been located, although a very small amount of alluvial gold has been obtained.

(v) The virtual absence of any significant gold deposition in the meta-sediments of the Day Dawn-Cuddingwarra synclinorial.

It would seem, within the Area, that:—

(i) Two favourable broad horizons for gold deposition exist.

(ii) Major deposition is confined to the western limb and north plunging nose of the anticlorium.

(iii) There is an upper limit of gold deposition as indicated by the virtual barrenness of the Day Dawn-Cuddingwarra meta-sediments.

No studies of localisation of ore bodies could be made owing to the essentially reconnaissance nature of the work, but the known association of the Fingall ore bodies with the warping and folding of the Day Dawn meta-dolerite still may be a typical structural control on the limbs of the anticlinorium. On the steeply north plunging nose of the regional structure, localisation of ore bodies may be related to shear patterns consequent upon the regional folding. More detailed studies are required.

Gold, in the free milling state, occurs within the Area associated, sometimes strongly, with pyrites, arsenopyrites, chalcopyrites, and to a very small degree with bismuth bearing sulphides. The association of gold and arsenopyrite is usually indicative of increasing gold values. Of significance is the distribution of these associated metals, the gold-copper-arsenic association being confined to the western limb and nose of the structure in the broad horizon of the basic lavas. The gold-arsenic-bismuth suite appears confined to the Pinnacles portion of the eastern limb—again in the broad horizon. In addition to the foregoing minerals, the following have been recorded in the Area:—

Sphalerite.
Galena.
Pyrrhotite.
Scheelite.

Recommendations.

The nature of the survey precludes any but very general recommendations. Accordingly it is suggested that further prospecting may be repaid in:—

(i) The area between Day Dawn and Lake Austin along the zone of the meta-dolerite sill.

(ii) The anticlinorial nose in the vicinity of the Mainland and Lake Austin, where the structure is breached by the Lake.

Water Supplies.

For the benefit of those interested in prospecting the following water points within the area are given:—

Well or Shaft.	Depth and Water Level.		Capacity.	Remarks.
	Depth Feet	W.L. Feet	G.p.h.	
Moyagee	80	30	?	
Holts Well	66	2	25	
Marchesi's Well	45	29	30	Good stock water.
State Well	84	48	80	Brackish.
Pinnacles Well....	53	51	450	Fresh.
Mainland Well....	60	31	40	Fresh.
Garden Granite	80	70	80	Fresh.
Louise Well	86	70	20	Good stock water.
Day Dawn Town Well	73	50	68	Fresh.
Sanitary Well	70	48	27	30 grs. salt.
Rose of England	175	118	100	70 grs. salt.
St. Albans	?	70	2,500	Salt, 150 grs.
H.L. 25	86	65	70	34 grs. salt.
Yarraquin Dairy Well	70	58	108	58 grs. salt.
Slaughter Yard Well	?	62	480	44 grs. salt.
Brewer's Well	?	?	1,000	28 grs. salt.

REPORT ON PROGRESS OF A GEOLOGICAL SURVEY of the METROPOLITAN AREA AS AT 31/12/50.

By J. C. McMath, B.Sc. (Hons. Lond.), F.G.S., M.A.I.M.M., Senior Geologist.

CONTENTS.

Introduction.

Past work of the Geological Survey in the Metropolitan Area has largely centred about economic aspects of geology—usually related to specific problems, e.g. water supply, brickmaking materials, limestones, etc. Unofficial work has concerned itself with more academic aspects of local geology. Resulting from this work is a large and diverse literature, usually strictly localised in character. The Metropolitan Area, until the present work, has never been systematically investigated in its geological entirety—the sole geological map of the

Area being a compilation from the unpublished maps of the late H. P. Woodward (a former officer of the Geological survey).[11]

Economic pressures and the accelerated expansion of the metropolis in space and industrial activity emphasied the need for an overall knowledge of the fundamental geology and geological resources of the Area. To this end the present work was undertaken. Its objects are:—

(i) Location and appraisal of industrial rocks and minerals within the Area.
(ii) Indication to interested parties of possible sources of such raw materials as are in urgent demand and short supply.
(iii) Reconnaissance investigation of the hydrogeology of the Area.
(iv) A broad outline of contemporaneous land utilisation within the Area.

The achievement of these objects necessitated detailed geological mapping of the Area. This was started on 14th August, 1950.

Industrial Liason.

To relieve, as rapidly as possible, urgent demands upon local geological resources required rapid means of:—

(i) Evaluation as to industrial suitability of materials sampled.
(ii) Assessment of scale of use.
(iii) Equitable distribution of information to interested parties.

This was achieved, more or less satisfactorily, through the Chamber of Manufactures of W.A. and its sub-organisations together with the State Brick Works and Western Australian Government Railways.

Evaluation as to suitability of materials was undertaken by:—

(i) Brisbane & Wunderlich Ltd. with respect to ceramic materials—including tile clays.
(ii) State Brick Works—with respect to brick earths and shales.
(iii) Tomlinson Steel Pty. Ltd. and Western Australian Government Railways with respect to natural and synthetic foundry sands.
(iv) Geological Survey of W.A.—approximate estimation of total carbonates in limestones.

Distribution of information takes the form of interim reports which are circulated to industry through the Chamber of Manufactures of W.A.

Industrial Rocks and Minerals of the Area.

The chief industrial rocks and minerals which may occur are:—

Clays and Shales—brick, tile, pipe making.
Clays—minor ceramic uses—cement.
Sands—foundry uses, glass, filters, etc.
Diatomaceous earths—filters, etc.
Gravels—road surfacing—aggregate material.
Limestone—chemical, industrial, and agricultural uses—dimension stone.
Marls—agricultural uses, etc.
Salt—industrial uses.
Refactories other than clays and shales (possible in the Pre-Cambrian rocks).
Igneous and Metamorphic Rocks—dimension stone and aggregate material.

Definition of the Area.

The maximum area authorised for investigation extends from the latitude of Muchea southwards to that of Safety Bay. The eastern boundary of the Area approximates that of Glen Forest.

For convenience of operation, determined by demand priorities of materials (clays, limestones, foundry sands), communications, and proximity to the city, the Area was sub-divided into areas centred about Armadale, Bullsbrook, and the city of Perth. The foregoing considerations, together with existing geological information, determined the order of treatment—Armadale being first, followed by Bullsbrook, with the built up city area last.

A start was made on 14th August, 1950, in the Armadale area which was completed in mid-December. Some 500 square miles were mapped to a scale of 20 chains—1 inch, prospected, and sampled. Some 145 samples were taken and are in the course of evaluation for industrial suitability. Where testing of samples warranted, "follow-up" boring with hand equipment was carried out.

Reference Maps to the Metropolitan Area as defined for the purpose of this Survey are:—

Lands and Surveys Department Lithos:—

29/80—31/80, 341A/40, 341B/40, 341C/40, 341D/40.

Military Maps 1 inch=1 mile.

Mundaring	Zone I No. 309
Yanchep	Zone I No. 392
Toodyay	Zone I No. 393
Perth	Zone I No. 398
Fremantle	Zone I No. 404
Kelmscott	Zone I No. 405
Rockingham	Zone I No. 410
Jarrahdale	Zone I No. 411

Sample and locality references are, for convenience and brevity, given in terms of the military grid. This grid will be incorporated on the published geological map. For results of sample testing to date, reference may be made to Appendix I.

Personnel.—Six professional officers (including one temporary) were engaged upon this survey during the period. They were:—

Geologist.	Function.	Period.
J. C. McMath	In charge	14 Aug.–31 Dec., 1950
N. M. Gray	Field duties	14 Aug.–31 Dec., 1950
J. Sofoulis	Field duties	14 Aug.–31 Dec., 1950
L. E. de la Hunty	Field duties	14 Aug.–31 Dec., 1950
G. H. Low	Field duties	14 Aug.–31 Dec., 1950
A. Glance	Field duties	14 Aug.–18 Dec., 1950

The Armadale Sub-area.

1.—Communications.

Armadale is situated 18 miles south of Perth upon the Perth-Bunbury railway at the junction with the main line with a spur to Fremantle. Major north-south roads are:—

(i) Perth-Bunbury road—which skirts the foot of the Darling Range.
(ii) Fremantle-Mandurah road.
(iii) Armadale-Fremantle road.

These major highways are connected by a plexus of dirt roads—road accessibility in the area can be rated as very good. South of Serpentine the east-west accessibility becomes poor.

2.—General Geological Outline.

From east to west the broad geological elements of the Armadale sub-area are:—

(i) The Pre-Cambrian rocks of the Darling Range and scarp. These consist of granite gneisses and minor epidioritic intrusives. On their western margin they are flanked by the Pre-Cambrian meta-sedimentary Cardup Series—of economic interess by reason of the shales in the lower portion. The Cardup Series has been traced from Gosnells to Serpentine. Associated with these rocks are Recent residual deposits such as clays and laterites.

[11] Handbook Aust. Assoc. Adv. Sci.—Perth, 1926. "The Geology and Physiography of the Neighbourhood of Perth."—E. de C. Clarke.

(ii) A piedmont zone on the western slopes of the scarp consisting of residual deposits together with alluvial fan material. This zone is variable, though narrow, in width. The deposits of this zone are Recent in age.

(iii) Succeeding the abovementioned zone is one of vegetated siliceous sand dunes which are dissected by diverse, and interrupted, drainage systems. The major drainage systems are those of the Canning and Serpentine Rivers and the Wongong Brook. Clays and loams are confined to these drainage lines. Westwards these argillaceous deposits become estuarine in character and appear to underlie the vegetated siliceous dunes. At present these clays are considered late Tertiary in age; the siliceous dunes may be of a like age.

(iv) A coastal belt of calcareous sand-dunes which are vegetated. These dunes are fringed on the coast by "live" dunes deriving from the present beach. Between these calcareous sand-dunes, which form positive relief features, and the coast in the Rockingham-Safety Bay locality are a well defined series of old beach ridges paralleling the present coastline—they consist of highly calcareous sands and are vegetated. These calcareous sand-dunes and beach ridges overlie the marine element of the Coastal Limestone Formation. Present sampling indicates that these calcareous sands become less calcareous eastwards and southwards of Perth. "Cap Rock" areas become progressively more sparse southwards until they become obvious "pinnacles" of secondary enrichment controlled by vertical jointing. These calcareous sand-dunes and vegetated siliceous dunes are breached, in the south-west, by the Serpentine River.

(v) Westwards of, and fringing, the piedmont zone, and extending westwards to the coast, are a series of lakes some of which may be dry seasonally. They consist in part of portions of disconnected drainage systems, local slight depressions, and—in the case of White and Salt Lakes just to the east of Rockingham—former coastal lagoons. Their chief economic importance lies in their deposits which are "marls," sometimes with a total carbonate content of 90 per cent.

3.—Brief Outline of Economic Results.

Reconnaissance sampling of the Armadale sub-Area has been completed and some "follow up" boring carried out in the light of test results to hand. The materials sampled are:—ceramic materials, brick materials, limestones, and foundry sands.

(i) Ceramic and Brick Clays—materials, limited in extent and liable to lateral and vertical variation in quality, occur along the piedmont zone at the foot of the Darling Scarp and include poor grade kaolinitic materials. Kaolinitic clays from the Darling Range offer, upon levigation, possible pottery clays. Otherwise they may have uses as low grade refractories or for "fancy" bricks. The known extension of the shales of the Lower Cardup Series from Gosnells to Serpentine offers adequate reserves of this material.

The major prospects for ceramic and brick clays are confined to the Serpentine, Wongong, and Canning River Belts. The latter Belt, exploited from the early days of Perth, is becoming more and more encroached upon by urban development and is offering problems of land values and utilisation to the development of industries based upon clays and loams. The Serpentine and Wongong Belts, showing in their central and western portions depths of 18 feet of clays and loams, offer very adequate reserves of ceramic and brick clays of diverse suitability. It is anticipated that, owing to water logging, exploitation of these reserves would be seasonal.

(ii) Foundry Sands—(a) "Natural Sands.—All samples tested to date have been rejected on the score of coarseness and over high iron content. These "natural" sands are river loams (together with loams from the piedmont zone) and samples, generally representative, were on a reconnaissance basis. The results are not unexpected and emphasis the fact that acceptable "natural" sands have a very limited vertical and horizontal distribution. In any one locality a deposit varies greatly in a short distance—e.g., the Guildford loams at present in use. Limited quantities of "natural" sands can only, then, be located by very close prospecting of loams mapped during the course of the survey. Their location becomes a special operation outside the province of the Geological Survey.

(b) Synthetic Sands.—Sources of synthetic sands —a silica sand to which a banding agent such as bentonite is added to produce a foundry sand to specification—are confined to the medium belt of siliceous and vegetated dunes. Within this belt location of a particular grade of sand is best attempted from a consideration of dune structures—top, fore, and bottom setting of materials—the top and bottom set sands being coarser than the fore set sands. Thus, for medium grade sands, the probability lies in their occurring on the eastern flanks of these siliceous dunes. Samples tested have not proven acceptable to the rigid specifications of the testing firm for use within their own foundry (steel) but offer possibilities to other users whose specifications are less rigid or whose work is of a different nature. For a particular foundry use demanding very rigid specifications, washing to a particular grade size range might prove practicable.

(iii) Limestones—(a) Chemical Limestones.—Industrial demand is for a $CaCO_3$ content of 80 per cent. or more. This specification limits severely the use of the calcareous sand-dunes. The general distribution of calcium carbonate in these dunes has been remarked elsewhere and the recommendations for detailed prospecting (entailing a fair boring programme) of K. R. Miles[12] are repeated. Apart from prospects arising from such a boring programme, no reserves of "Cap Rock" commensurate with industrial demand can be seen with regard to these calcareous dunes.

Calcareous lacustrine deposits offer, as it appears at date of writing, better porspects. Two definite prospects, together with a third which remains to be sampled in more detail, exist. These are:—

(a) Wongong Brook (Location 31 and Adjacent Ground).—Some 130 acres are known of average depth 12ft., although depth is variable. Samples indicate, so far, approximately 80 per cent. total carbonates. The "marl" or soft limestone bottoms on a green-brown calcareous clay. The presence of the clay may be an asset from the cement manufacturing point of view. Further detailed work is required, but the occurrence—thought to be an old arm of Lake Jandakot—remains a major chemical lime prospect.

(b) White Lake, on Rockingham-Mandurah Road.—This was grid bored, when dry, in 1914. Sampling showed an average of 86 per cent. carbonates to an average depth of 15ft. over 1.75 square miles. Only 1.5 per cent. SiO_2 was noted, the balance consisting of organic matter. This project offers 60-80 years reserves on a 200,000 ton per year production basis.

(c) Salt Lake, which lies just to the south of White Lake, and separated from it by a sand bar, has not been grid bored but sampling to date has indicated a general likeness to White Lake both in total carbonate content and possible reserves. Further work is required, when the lake is dry, to confirm these indications.

Both these prospects are situated on the Fremantle-Mandurah road some 18 miles south of Fremantle.

Other similar calcareous deposits are known of approximately the same tenor —e.g. Lake Coogee—but are very much more limited in extent and have problems of land utilisation and values attached.

(b) Dimension Stone—two types of dimension stone are obtained from the calcareous dunes of the Coastal Limestone Formation. The first is a

[12] Ann. Prog. Rept. G.S.W.A., 1944, p. 50.

fine grained, compact, sectile stone with a clay content. This stone, upon weathering, leaves as a residue a pink to red coloured terra rossa which is diagnostic. Largely confined to the Spearwood locality, this type grades southwards into the more arenaceous second type.

The second type gives rise to a lighter coloured more quartzose soil. South of the 12 Mile Peg on the Fremantle-Rockingham road, the stone becomes too siliceous for use as a good building stone. In detail, suitable stone is localised by dune structure and occurs on the westward, windward, side of the vegetated dunes. An economic eastward limit to quarrying operations is set by the crest-line of a particular dune and the incoming of the thin lenticular fore set beds. Building limestones should be prospected for accordingly.

(iv) Road Metals and Aggregates.—(a) Lateritic Gravels—are confined to the piedmont zone and the Darling Range. The piedmont zone offers the most accessible and largest reserves. The gravels of the Darling Range are limited in occurrence and extent and are largely confined to pockets, usually at the heads of gullies, along drainage lines.

(b) "Blue Metal"—is derived from the dolerite and epidiorite intrusives in the Pre-Cambrian granitic gneisses of the Darling Range. Adequate reserves exist.

(c) Sand—sand, as builder's sand, has a wide distribution in the zone of vegetated siliceous dunes and adequate reserves exist. Limited quantities of sharp, ill-sorted, silica sands occur on the Darling Range and contain varying amounts of kaolinitic fines.

(v) Silica—Occurs massive in two forms:—

(a) Quartz reefs in the Pre-Cambrian complex of the Darling Range. The major body is that worked at Gosnells by White Rock Quarries. This body contains adequate reserves for all likely demands.

(b) Quartzites occuring in the Lower Cardup Series—these quartzites could supplement the previously remarked reserves.

(c) Silica sands of the vegetated siliceous dunes—whilst dominantly siliceous, there is a small but variable iron content.

Summary.

The geological survey of the Metropolitan Area —2,000 square miles centred about Perth—was undertaken to delineate the geology of the Area with particular reference to economic aspects. The necessity for this work, actually long overdue, arose by reason of social and economic pressures consequent upon World War II and long term development of the Area. To satisfy, where possible, urgent demands upon and shortages of industrial rocks and minerals rapid assessment of suitability of materials to industry and transmission of information to affected parties was necessary. This was done through liaison with the Chamber of Manufactures of W.A. and ancillary bodies.

Initial Field Mapping—to a scale of 20 chains to one inch—started on 14th August, 1950, and was centred about Armadale. Some 500 square miles were completed by 31st December, 1950.

Resulting from this work were the following points:—

(i) The establishment of adequate clay reserves—the chief being the Wongong and Serpentine Belts—suited to general ceramic uses and brick making.

(ii) The tracing of the Cardup Shales, of brickmaking and ceramic interest, from Gosnells southwards to Serpentine.

(iii) The location and partial assessment of three major chemical limestone prospects —those of White and Salt Lakes (Rockingham) and Wongong Location 31, together with a more general appreciation of the lime potentialities of the Coastal Limestone Formation. These potentialities are very limited and largely confined to the Naval Base locality and require demonstration by boring.

(iv) The concrete realisation that "natural" foundry sands are limited in quantity and extremely variable in characteristics within any one particular locality. "Natural" foundry sands reserves of significance were not established. Of "synthetic" sands—i.e. silica sands—good potentialities were seen, some beneficiation with regard to grade to suit a particular type of foundry work might prove an economic possibility. Results of industrial testing of industrial rocks and minerals sampled are given in Appendix I. Field work during 1951, will be centred about Bullsbrook, and will finish with the mapping of Perth and its built up environs.

Acknowledgments.

The writer wishes to record his appreciation of the co-operation that he has received from both official and unofficial bodies and individuals too numerous for specific mention.

APPENDIX I.

CONTENTS.

Broad Results of Sampling.

Notes.

1. Source of test results is indicated by the abbreviated titles of the organisations who carried out the tests. These organisations and abbreviations are:—

H. L. Brisbane & Wunderlich Ltd.—B.W.
State Brick Works—S.B.W.
Tomlinson's Steel Pty., Ltd.—T.
Geological Survey of W.A.—G.S.W.A.
Western Australian Government Railways—W.A.G.R.

2. Locations of samples are given, as they will be indicated in the completed work and maps, as a military grid reference to conform with the field-sheets. When possible, the approximate position of a sample will be referred to a Location Number (ref. L. & S. Lithos).

3. Owing to time lags only those sample results in hand are given.

Clays and Loams.

Notes.

1. For remarks on the Serpentine and Wongong Clay Belts, see page 52.

2. When tests have not been completed, preliminary results will be given.

Sample No. G.S.M. 7: Map reference 945078, 200 yards W. of N.W. corner of Cockburn Sound Location 271.

	%
Drying Shrinkage	4.7
Total Fired Shrinkage—	
1112°C	4.7
1160°C	4.7
Fired absorption—	
1120°C	17.1
1160°C	16.7

Colour—light brown—poor.
Salt Glaze—poor, body to porous and soft.

Could be used as minor constituent in red burning ware to improve drying and reduce firing shrinkage, but otherwise not generally suitable for ceramic purposes. (B.W.)

Sample No. G.S.M. 10: Map reference 947049, N.W. corner of Cockburn Sound Location 50.—A brown loamy clay with just fair elasticity. It has good drying characteristics and fairly good dry strength.

	%
Drying shrinkage	4.7
Total Fired shrinkage—	
1120°C	5.8
1160°C	7.1
Fired absorption —	
1120°C	15.6
1160°C	15.8

Colour—fairly good red.

Salt Glaze—good—darkens colour considerably.

Reasonably good for extruded brick and agricultural drain tile, but just a little soft for the best product. The discrepancy between shrinkage and absorption at the two firing temperatures is due to the difference in kiln atmosphere. This clay could also be used with a stronger clay for roofing tiles. (B.W.)

Sample No. G.S.M. 12: Map reference 984045, 300 yards S.E. of N.W. corner peg of Cockburn Sound Location 807.—A chocolate brown slightly loamy clay with fairly good plasticity. Drying characteristics are good, and dry strength is good.

	%
Drying shrinkage	5
Total Fired shrinkage—	
1120°C	9.0
1160°C	badly warped
Fired absorption—	
1120°C	14.5
1160°C	10.3

Colour—very dark red with black ironstone particles.

Salt Glaze—good—darkens colour.

This firing temperature is a little high for this clay.

Fired at a lower temperature (about (1050°C), this should be entirely suitable for extruded brick. Strength is good. Not satisfactory for other products. (B.W.)

Sample No. G.S.M. 15: Map reference 927118, 100 yards W. of S.W. corner peg Cockburn Location 245.—A dark grey, very plastic and tough clay, having excellent dry strength. Tends to warp in drying, but this is typical for these very plastic clays. Does not crack in drying, and in general drying characteristics are good.

	%
Drying shrinkage	9.6
Total Fired shrinkage—	
1120°C	11.4
1160°C	12.1
Fired absorption—	
1120°C	11.1
1160°C	11.2

Colour—pleasant medium red.

Salt Glaze—excellent with a very nice reddish brown colour.

Fired strength is good and surface very good. This clay would be suitable, mixed with a less plastic clay, for extruded brick, roofing tiles, sewer pipe and all other types of red burning ware. Altogether, a good clay. (B.W.)

Sample No. G.S.M. 18: Map reference 863068, 100 yards S.E. of N.W. corner Cockburn Sound Location 471.—A grey brown clay, slightly loamy but very plastic and tough. Warps slightly in drying but is all right. Good dry strength.

	%
Drying shrinkage	8.7
Total Fired shrinkage—	
1120°C	11.3
1160°C	12.2
Fired absorption—	
1120°C	11.1
1160°C	11.0

Colour—light brownish red. Only fair colour.

Salt Glaze—Readily glazed, but gives surface cracking.

Very hard body, but rather poor surface. Will make quite a good extruded building brick, particularly if broken down with a less plastic clay or other material. Not preferred for other products. (B.W.).

Sample No. G.S.M. 19: Map reference 841069, S.W. corner Cockburn Sound Location 450.—A dark grey, almost black, clay very plastic and tough. Warps slightly in drying, but not more than expected for its plasticity and toughness. Otherwise it dries very well, and has very good dry strength.

	%
Drying shrinkage	9.2
Total Fired shrinkage—	
1120°C	11.4
1160°C	11.4
Fired absorption—	
1120°C	11.9
1160°C	12.0

Colour—fair medium light red.

Salt Glaze—Readily glazes, but causes surface cracking, colour pleasing, reddish brown. Very hard body, but fairly poor surface. Suitable for extruded brick. A mixture with a second less plastic clay will improve this clay. Not preferred for roofing tiles or sewer pipes, but could be used as one clay of a mixture. (B.W.).

Sample No. G.S.M. 23: Map reference 938080, S.E. corner of Cockburn Sound Location 266.—A medium light brown colour, plastic and tough, but only slightly fatty.

	%
Drying shrinkage	7.0
Total Fired shrinkage—	
1120°C	14.1
1160°C	15.2
Fired absorption—	
1120°C	10.7
1160°C	10.2

Colour—medium brownish red—fair.

Salt Glaze—Fair, darkens colour and causes fine surface cracking. Fired strength is good.

While the colour is only fair, it is satisfactory. Slight surface cracking, which can be overcome by blending with another clay, is the main fault. However, this clay can be used for roofing tiles, sewer pipe, or extruded brick. (B.W.).

Sample No. G.S.M. 24: Map reference 869055, seven chains S.W. of S.W. corner Cockburn Sound Location 473.—Grey brown colour, very plastic and tough and fairly fatty. Contains small amount of sand loam. Dries fairly well with good dry strength.

	%
Drying shrinkage	8.9
Total Fired shrinkage—	
1120°C	11.0
1160°C	11.3
Fired absorption—	
1120°C	12.0
1160°C	11.2

Colour—brownish red, not so good a red as G.S.M. 23 above.

Salt Glaze—readily glazed, darkens a little and causes slight surface cracking, but is good.

Fired strength is good. Warps some in fire. The colour is not a real good red, but otherwise this clay is suitable for roofing tiles, sewer pipe, and extruded bricks. (B.W.).

Sample No. G.S.M. 26: Map reference 829057, S.E. corner peg Cockburn Sound Location 508.—Very dark grey colour, almost black, plastic, tough and fatty. Contains small amount of sand. Dries fairly well with very good dry strength.

	%
Drying shrinkage	10.6
Total Fired shrinkage—	
1120°C	13.6
1160°C	13.3
Fired absorption—	
1120°C	12.9
1160°C	13.1

Colour—a light red Terra Cotta, but very clean.

Salt glaze—Fair, changes colour to a medium brown and causes some fine surface cracking.

Fired strength is good. Warps slightly in fire. Colour is rather light, but this clay is suitable for manufacture of roofing tiles, sewer pipes and extruded bricks. (B.W.).

Sample No. G.S.M. 27: Map reference 853055, 20 chains N. of N.E. corner Cockburn Sound Location 560.—This clay is dark grey in colour, plastic, tough and fatty. It contains a small proportion of sand. Dries well with fairly good dry strength.

	%
Drying shrinkage	9.7
Total Fired shrinkage—	
1120°C	12.8
1160°C	12.8
Fired absorption—	
1120°C	8.5
1160°C	8.5

Colour—fair brownish red.

Salt Glaze—glazes readily, darkens colour to reddish brown. Surface cracking is pronounced.

Fired strength is very good.

This clay is suitable (with the addition of another clay to stop surface cracking) for the manufacture of roofing tile, sewer pipe, and extruded brick. Firing range, as shown by shrinkage and absorption figures, is particularly good. (B.W.).

Sample No. G.S.M./G/50: Map reference 827975, drain S.W. corner Cockburn Sound Location 1122.—A dark brown clay containing coarse non-plastics, mainly sand. Plasticity is good. Clay grain is fine and clay is sticky. Very difficult to dry and tends to warp badly.

	%
Drying shrinkage	12.5
Total Fired shrinkage—	
1230°C	15.5
Fired absorption	10.3

Colour—deep red with darker iron staining.

Cracks badly but, except for cracks, is very strong.

No use alone, but could be used with a weak clay for bricks and possibly tiles. Further samples to be fired in salt glaze kiln. (B.W.).

Sample No. G.S.M./G/52: Map reference 832015, road junction S.W. corner Cockburn Sound Location 953.—A fairly dark brown coloured clay. Appears to be free of any appreciable quantity of sand or other non-plastics. It is coarse grained, slakes readily, only slightly plastic and sticky. Dries well and fair dry strength.

	%
Drying shrinkage	10.9
Total Fired shrinkage—	
1230°C	16.5
Fired absorption	14.8

Colour—excellent red with small black specks.

Strength is good. There is no checking or cracking. Appears to be suitable for 1st quality face brick. Might be useful in roofing tile mixture. (B.W.).

Sample No. G.S.M./G/53: Map reference 820028, drain S.W. corner Sockburn Sound Location 924.—Very similar in properties to G.S.M./G/50.

	%
Drying shrinkage	13.2
Total fired shrinkage—	
At 1230°C	14.9
Fired absorption—	
At 1230°C	8.0

Colour—deep red with dark iron staining.

Cracks very badly in fire. Hard and, except for cracks, is very strong.

No use alone but might be used with other weak clays for bricks or possibly tiles. Must be used with care. (B.W.)

Sample No. G.S.M./G/54: Map reference 855025, 1,000 feet E. of N.W. corner Cockburn Sound Location 1106.—This is a dark brown colour sample containing some sand. This is a low density material. A cube was pressed and fired to 1050°C to test heat insulation value.

	Cubic cms.
Dry vol. of cube	54.0
Fired vol. of cube	46.2
	grams.
Fired weight of cube	43.5

Apparent sp. gr. 0.94 or 58½lbs./cu. ft.

This is too heavy for insulating material.

Clay slakes readily and is fairly plastic, but rather sticky and spongy.

	%
Drying shrinkage	3.5
Total fired shrinkage—	
1230°C	9.4
Fired absorption—	
1230°C	46.5

Colour—cream.

Only medium strength but good solid body, free from cracks. Should be useful as a second clay in roofing tiles or sewer pipes. (B.W.)

Sample No. G.S.M./G/51: Map reference 827995, drain S.W. corner Cockburn Sound Location 994.—Similar to G.S.M./G/50 and 53. The only difference is the colour being a little lighter in this sample.

	%
Drying shrinkage	10
Total fired shrinkage—	
1220°C	12.5
Fired absorption—	
1220°C	10.7

Colour—good deep red.

Some warp in firing. Fairly bad cracking. Body is hard. No use alone but might be used with a weak clay for bricks or tiles. Must be used with care. (B.W.)

Sample No. G.S./H/1005: Map reference 044150, Cockburn Sound Location 802, 10 chains S. of N.E. corner.—This is a very light greyish brown coloured ball clay or semi-ball clay. It is fairly difficult to deflocculate. Washing gave a non-plastic residue of 30.6%, consisting mainly of sand but with some unslaked or non-plastic clay substance which readily passed through a 100 mesh screen. The clay is quite tough and has fair plasticity. Good to press in moulds.

Drying shrinkage 6.3%. Good dry strength.

	%
Drying shrinkage—	
Good dry strength	6.3
Total fired shrinkage—	
1230°C	15.6
1400°C	18.7
Fired absorption—	
1230°C	8.6
1400°C	6.5

Colour—cream.

Quite a little surface checking extending into body. Shrinkage is higher than normal and this with the surface checking is bad.

Washed Clay.

	%
Drying shrinkage	44.7
Total fired shrinkage—	
1250°C	200.2
Total fired absorption	1.2

Colour—grey cream.

Pottery Glaze Behaviour—good with no crazing in autoclave accelerated crazing test.

Not white enough for white dinner ware but good for coloured art ware. Must be washed with consequent loss of 30 per cent. material in washing. (B.W.)

Sample No. G.S./H/1006: Map reference 037160, Canning Location 716, three chains S.E. of N.W. corner of location 716.—A light grey coloured clay with some iron staining. It is a semi-ball clay, only moderately plastic, but very fatty. Good dry strength.

	%
Drying shrinkage	5.6
Total Fired shrinkage—	
Small bars—1250°	16.1
Large bars—1400°C	15.6
Fired absorption—	
1250°C	10.9
1400°C	9.6

Colour—1250°C light cream, 1400°C—light grey.

Pottery glaze fairly good and no crazing. Surface is fairly rough and badly checked. Some of the cracks extend into the body. Body is strong but is not a generally useful clay, because of the surface cracking. (B.W.).

Sample No. G.S./S/2002: Map reference 015295, Canning Location 30A.—This clay is a medium yellow-brown in colour, *very* plastic, tough and fatty. Contains no appreciable sand or loam. Dries fairly well with good dry strength.

Fired absorption—	
Drying shrinkage	10.75
Total Fired shrinkage—	
1120°C—Sample broken	
1160°C	17.5
Fired absorption—	
1120°C	3.7
1160°C	3.3

Colour—dark reddish brown with black unoxidised case. Overfired for best colour.

Salt Glaze—excellent.

Fired strength is very good with no cracking or warping.

The clay is overfired at 1120°C.

This is a fine grained clay somewhat similar to clay from the Pyrton Estate, Guildford. It is suitable for the manufacture of roofing tiles and extruded brick with the addition of a second clay to open it up and reduce shrinkage. It is probably too fine grained for sewer pipes.

Sample No. G.S./S/2004A (Top Sample): Map reference 004295, Canning Location 30, W. side of highway.—Grey colour, fairly plastic, tough and fatty. Contains a considerable proportion of sand. Dries very well, but dry strength is only fair.

Drying shrinkage	5.5
Total Fired shrinkage—	
1120°C	6.5
1160°C Sample lost.	
Fired absorption—	
1120°C	16.3

Colour—very light brown, very slight surface seam.

Salt Glaze—Poor at this temperature. Too soft and porous.

Fired strength—poor.

Not suitable for roofing tiles, sewer pipes or bricks. May be a good refractory bond clay or medium grade refractory. (B.W.).

Sample No. G.S./S/2004B (Bottom Sample): Lighter colour than sample G.S./S/2004A, and the sand content is finer grained. Otherwise similar. Fairly plastic, tough and fatty, dries well but with only fair dry strength.

Drying shrinkage	6.3
Total Fired shrinkage—	
1120°C	7.8
1160°C Sample broken.	
Fired absorption—	
1120°C	18.0
1160°C	17.6

Colour—dirty cream.

Salt Glaze—poor at this temperature. Too soft and porous.

Fired strength—very poor at this temperature.

Remarks—same as G.S./S/2004A. (B.W.)

Sample No. G.S./L/3001: Map reference 005348, Canning Location 15.—It is a light grey colour, and is very plastic and tough. It contains approximately 60 per cent. clay substance and 40 per cent. non-plastic, mainly silica.

Sample fired to 1400°C.

	%
Total shrinkage	13.4
Fired absorption	5.8

Colour—light warm brown.

Strength—very good.

A little too refractory for true stoneware. Would be useful as a bond clay in medium grade refractories. (B.W.)

Sample No. G.S./L/3001: Supplementary report.

	%
Drying shrinkage	5.6
Total Fired shrinkage—1240°C	13.9
Fired absorption—1240°C	6.4

Colour—very light brown.

Glaze behaviour using standard pottery glaze is fairly without crazing.

Very hard body.

As this clay was first considered as a pottery clay, a portion was washed. Sixty per cent. was retained as clay substance, and after removing excess water was pressed into bars, dried, and fired. The non-plastic portion is highly siliceous.

Washed Clay.

Is a plastic tough clay, slightly sticky, but with finish very smooth with knife or palette. Good drying characteristics and good dry strength. Colour is light brown.

	%
Drying shrinkage	7.7
Total Fired shrinkage—1240°C	19.1
Total fired absorption—1240°C	0.45

Colour—brownish grey.

Glaze behaviour with standard pottery glaze—excellent with **no** craze.

Best possibility for this clay is for vitreous stoneware. It will require firing to at least 1300°C. It is a very good clay for this purpose, but not quite as smooth as the ideal. (B.W.)

Sample No. G.S./L/3002: Map reference 982348, Canning Location 16.—A dark reddish brown clay containing a little loam. Plasticity and dry strength are very good. There is a tendency to crack in drying, and a second good drying clay would have to be used with this to make a reasonably safe drying body.

	%
Drying shrinkage	7.3
Total Fired shrinkage—	
1120°C	13.3
1160°C	14.8
Fired absorption—	
1120°C	13.5
1160°C	11.7

Colour—dull brownish red.

Salt Glaze—very good, colour very dark.

Fires very hard with good smooth surface. Shrinkage is rather high and drying without cracks is difficult. Mixed with a clay having less shrinkage and better drying characteristics, this clay would be useful for extruded bricks, agricultural drain pipes and possibly for roofing tiles and sewer pipes, but is not preferred. (B.W.)

Sample No. G.S./L/3004: Map reference 961374, Canning Location 3.—A medium red clay, fairly loamy but with good plasticity and dry strength. There is a tendency to crack in drying, and must be dried with care.

	%
Drying shrinkage	6.8
Total fired shrinkage—	
1120°C	10.2
1160°C	9.5
Fired absorption—	
1120°C	15.7
1160°C	14.8

Colour—dark reddish brown, poor.

Salt Glaze—fairly good, colour very dark.

Fairly hard body and good surface. Mixed with a clay having better drying characteristics this would be suitable for extruded brick and will not require firing to quite as high a temperature. Lower firing temperature will also brighten and improve the red colour. Discrepancy in shrinkage of the higher fired sample is due to some cracking occurring. (B.W.)

Sample No. G.S./L/3019: Map reference 051363, Canning Location 313.—A fairly white china clay, with a slightly shaley texture. It slakes readily, is fairly plastic, fine grained and fatty. A good clay to work. Washing gives 84.4 per cent. plastic and 15.6 per cent. of non-plastic material. Drying characteristics are fairly good and dry strength is good.

Whole Clay—

	%
Drying shrinkage	6.7
Total Fired shrinkage—	
1250°C	17.6
Fired absorption	14.1

Colour—cream with small brown specks.

Glaze—very good, no craze, strength good.

Washed sample—good dry strength—

Drying shrinkage	5.7
Total Fired shrinkage—	
1250°C	19.2
Fired absorption—	
1250°C	7.6

Colour—cream.

Glaze—very good, with no craze. Very faint brown specks showing under the glaze.

This is a clay which is worth further testing for use in pottery and dinnerware body. It seems reasonably good. (B.W.)

Sample No. G.S./L/3021: Map reference 108331, Canning Location 164.—This is a light grey sandy clay. Plasticity is poor but can be washed all right. Drying is good and clay strength is good.

	%
Drying shrinkage	6.6
Total Fired shrinkage—	
1120°C	8.0
1400°C	11.8
Fired absorption—	
1120°C	32.2
1400°C	23.8

Colour—fairly white.

Salt Glaze—1120°C—nil—slight surface checking.

Strength—poor at 1120°C and only fair at 1400°C.

This clay is too sandy but might be useful in roofing tiles or bricks to improve drying of a stronger clay. (B.W.)

Sample No. G.S./L/3012: Map reference 977359, Canning Location 13.—A dark yellow brown clay with good plasticity. Contains a small quantity laterite pebbles up to ¼in. Dries well with very good strength.

	%
Drying shrinkage	9.7
Total Fired shrinkage—	
1120°C	20.0
1160°C—sample lost.	
Fired absorption—	
1120°C	5.9

Colour—good red with dark spots from laterite pebbles.

Salt Glaze—fair.

Very slight warp but excellent strength. Shrinkage is very high. Will make good bricks fired at a lower temperature. (B.W.)

Sample No. G.S./L/3011: Map reference 983369, Canning Location 13.—Yellow brown clay with only fair plasticity but good working properties. Contains some quartz up to 1/16th inch. Dries well with very good dry strength. Dries almost like cement.

	%
Drying shrinkage	5.7
Total Fired shrinkage—	
1120°C	7.1
1160°C	7.4
Fired absorption—	
1120°C	14.7
1160°C	13.9

Colour—excellent red.

Salt Glaze—only fair.

A very slight warp. At these temperatures is rather soft for bricks. Might be all right fired harder. (B.W.).

Sample No. G.S./L/3006: Map reference 009338, Canning Location 52.—A reddish brown or chocolate coloured clay containing laterite pebbles up to ½ inch. It is very sandy and plasticity is only fair. Dries well with medium dry strength.

Drying shrinkage	6.7
Total Fired shrinkage—	
1120°C	6.7
1160°C	6.7
Fired absorption—	
1120°C	20.0
1160°C	19.7

Colour—good dark red.

Salt Glaze—poor (too porous).

Weak sandy body. No use alone but possibly could be used with one of the more plastic clays to improve drying and colour. (B.W.)

Non-plastic Content of Some Clays Tested by Working Away Clay Substance.

Sample No. G.S./G/25—52.9 per cent. non-plastic—coarse white sand.

Sample No. G.S./G/26—56.6 per cent. non-plastic—coarse white sand.

Sample No. G.S./G/27—41.0 per cent. non-plastic—coarse white sand.

Sample No. G.S./S/2004B—57.0 per cent. non-plastic—coarse sharp white sand.

Sample No. G.S./L/3012—67.6 per cent. non-plastic—fine loam, angular quartz, ironstone.

Sample No. G.S./G/12—65 per cent. non-plastic—sand and some ironstone.

Sample No. G.S./G/15—47 per cent. non-plastic—coarse sand.

Sample No. G.S./G/18—55.5 per cent. non-plastic—coarse sand.

Sample No. G.S./G/19—58.3 per cent. non-plastic—white sand. (B.W.).

Notes.

(i) Total carbonate determination by G.S.W.A.

(ii) High assays of cap rock only indicate a very general distribution. In general it is not expected that detailed work will prove reserves commensurate with anticipated demand.

(iii) Lower assays—which may prove of interest—again indicate only a general distribution, but it is expected that detailed work may show large reserves.

(iv) Marls are limited in thickness and extent and confined to the "lake" system. Lake Coogee and Wongong offer possibilities of quantity.

(v) The lime sands offer possibilities of quantity.

(vi) Based upon these investigations, interested parties can carry out detailed work.

MOULDING SANDS.

Natural and Synthetic.

Locations of Samples Treated and Considered of some Utility.

Sample No.	Military Grid Co-ordinates.	Approx. Location.
G.S./M/G/5	000060	300 ft. N. of S.W. corner Co. Sd. Location 408.
G.S./M/G/6	970118	S.E. corner Co. Sd. Location 239.
G.S./M/G/8	987094	700 ft. N.N.E. of N.E. corner Co. Sd. Location 212.
G.S./M/H/1003....	014189	Canning Location 186—5 chns. S.E. intersection Bunbury Highway and Wongong Brook.
G.S./M/L 3005....	968314	Canning Location 16.
G.S./M/L 3015....	896365	1½ miles N. of N. corner Canning Location 103.
G.S./M/G 44	885027	¼ mile N.W. of Bridge in Co. Sd. Location 16.
G.S./M/G 46	878958	100 ft. W. of N.W. corner Co. Sd. Location 403.
G.S./M/G 47	917025	300 yds. W. of S.W. corner Co. Sd. Location 728.
G.S./M/G 48	972968	400 yds. N. of S.W. corner Co. Sd. Location 92.
G.S./M/G 49	948004	N.W. corner Co. Sd. Location 594.

SAND TESTS FOR GEOLOGICAL SURVEY.
(W.A.G.R.)

A series of tests on sands submitted by the Geological Survey are listed below. The tests were performed with a view to determining suitability of the sands for foundry purposes.

Series A.

Markings: GS/M/L 3016, GS/M/L 3017, GS/M/L 3018, GS/M/L 3019.

Lab. No.: MO 30*.

10 Mesh	0.20
20 "	12.70
30 "	24.0
40 "	16.86
50 "	16.30
70 "	8.60
100 "	7.22
120 "	2.64
— 120 "	11.40

* Not suitable for foundry purposes.

These sands were visually examined in conjunction with the foundry foreman, in order to obviate unnecessary testing of sands which were definitely unsuitable for moulding.

The sand selected for testing is a coarse grained silica sand. This sand contains an undue percentage of fines but could be used as a base for a synthetic moulding sand.

Series B.

Markings:	44	FRS 46	AM 47	MO 5 48	FRI 49
Lab. No.	MO 31	MO 32	MO 33	MO 34	MO 35
Colour	Brown	Grey	White	Yellow	Yellow
Percentage retained on:					
10 Mesh	0·64	....	....	....	....
20 "	1·50	2·70	8·70	0·44	1·58
30 "	1·30	52·54	42·88	10·60	15·56
40 "	0·84	20·53	16·16	14·20	16·90
50 "	1·88	9·42	11·14	18·12	20·68
70 "	3·14	2·0	7·30	14·26	13·66
100 "	6·0	2·34	3·74	14·80	6·58
120 "	3·22	1·20	1·08	4·60	4·38
120 "	34·24	9·6	9·20	22·90	20·48
A.F. 8 Clay	47·30	....	....	....	....

Sample No. GS/M/G 44 is a brown loam and can be considered as more suitable than the red Guildford loam for non ferrous work. It is higher in the A.F.S. clay content than samples of Guildford loam. The proportion passing through the 120 mesh screen is below that of the red loam which has been tested in this laboratory. (It is assumed, of course, that the clay content is not extremely fine silt). This sample is worthy of further trial.

The silica sands contained undue amounts of vegetable material. They are not of outstanding quality for moulding sands. The two yellow sands are high in fines. The two white sands are coarse grained and would be suitable for backing sands when bonded.

14/2/51. W. Hoffman.

Material.	Sample No.	Military Map Co-ords.	Approx. Location No.	Total Carbonates. Per cent.	Remarks.
Limestones, Lime Sands, Marls.	G.S./29	814058	3 chns. south-east of N.W. peg Co. Sd. Loc. 294	89	Old quarry
	G.S./30	780123	N.E. corner Co. Sd. Loc. 17	84	Cap rock very limited
	G.S./31	760103	5 chns. south-west of N.E. peg Co. Sd. Loc. 130	50	Calcareous sandstone
	G.S./32	768121	20 chns. north-west of S.E. peg Co. Sd. Loc. 427	69	Calcareous sand
	G.S./34	808082	5 chns. north of S.E. peg Co. Sd. Loc. 610	91	Capstone—limited
	G.S./2015	780240		68	Coarse calcareous sandstone
	G.S./2005	749308		41	Lime sand
	G.S./2006	773252	S.E. corner Lake Coogee	98	Marl—4 ft. thick

Material.	Sample No.	Military Map Co-ords.	Approx. Location No.	Total Carbonates. Per cent.	Remarks.
Limestones, Lime Sands, Marls—*continued*	G.S./2008	958234	Canning Loc. 75	92	Marl—a prospect
	G.S./2010	963235	Canning Loc. 75	96	Marl—a prospect
	G.S./35	714051	Near Safety Bay	90	Lime sands
	G.S./36	745112	Near Safety Bay	61	Lime sands
	G.S./37	747089	Near Safety Bay	41	Lime sands
	G.S./4066	738089	Beach Ridges Rockingham-Safety Bay Area.	58	Lime Sand—old beach ridges
	G.S./4067	753094		37	Lime sand
	G.S./4068	743097		41	Lime sand
	G.S./4069	755101		47	Lime sand
	G.S./4070	744022		53	Lime sand
	G.S./4871	743014		58	Lime sand
	G.S./4072	738004		51	Lime sand
	G.S./4073	734035		72	Lime sand
	G.S./1008	784133	3 chns. north-east of S.W. corner Canning Location 617	58	Quarry—limestone
	G.S./1009	819134	130 chns. east of S.E. corner Canning Loc. 617	75	Quarry—limestone
	G.S./1010	780151	8 chns. east of N.E. corner Canning Loc. 359	83	Quarry—limestone
	G.S./1011	772182	22 chns. east of N.E. corner Canning Loc. 508	86	Outcrop limestone
	G.S./1012	770189	S.W. corner Canning Loc. 435	63	Limestone in road cutting
	G.S./1013	796175	30 chns. south of N.E. corner Canning Loc. 635	86	Limestone—caprock
	G.S./1014	768197	7 chns. north-east of S.W. corner Canning Loc. 382	92	Quarry—limestone
	G.S./1015	762220	2 chns. east of N.W. corner Canning Loc. 14	85	Limestone
	G.S./1016	765211	22 chns. north of N.W. corner Canning Loc. 510	93	Quarry—limestone
	G.S./1017	786197	3 chns. south-east of N.W. corner Canning Loc. 654	91	Quarry—limestone
	G.S./1018	794213	10 chns. south of S.W. corner Canning Loc. 226	91	Quarry—limestone
	G.S./55	718975	2,700 ft. north of N.E. corner Co. Sd. Loc. 682	88	Lime sand dune
	G.S./56	755974	Rd. Junction 2 miles east of S.E. corner Co. Sd. Loc. 682	51	Lime sand dune
	G.S./57	764962	1,000 yards north-west of Stale Hill	63	Lime sand dune
	G.S./60	767961	1,000 yds. north of Stale Hill	83	Limestone
	G.S./61	771974		88	Limestone
	G.S./62	779009	1.3 miles north of Karnup Road	88	Limestone
	G.S./63	781013		88	Limestone
	G.S./64	783032		88	Limestone
	G.S./65	787060	100 ft. north of N.W. peg Co. Sd. Loc. 302	76	Limestone
	G.S./66	795106	800 yds. north-east of N.W. corner Co. Sd. Loc. 302	87	Limestone
	G.S./67	788077		87	Limestone
	G.S./68	776106	100 yds. east of N.W. corner Co. Sd. Loc. 20	64	Limestone
	G.S./69	814117	300 yds. north of N.E. corner Co. Sd. Loc. 620	79	Limestone

TOMLINSON STEEL PROPRIETARY, LIMITED.

Sample No.	Colour.	Grain Class.	Organic Material.	A.F.A. Clay per cent.	A.F.A. Grain Size.	Screen.										
						10	20	30	40	50	70	100	140	200	270	Pan.
G.S. M/G/5	Fawn	Sub-angular	Small amount	1·36	45	0·04	0·27	7·81	32·5	23·54	25·29	3·14	3·33	1·08	0·49	0·86
G.S. M/G/6	White	Sub-angular	Small amount	1·19	57	0·0	0·34	4·43	16·89	18·56	35·77	9·58	7·25	3·29	1·21	1·36
G.S. M/G/8	White	Sub-angular to angular	Small amount	0·46	42	0·0	0·04	7·27	33·66	29·61	21·94	3·33	1·93	0·78	0·24	0·54
G.S. M/H/1003	Light brown	Angular	Small amount	14·56	88	1·08	3·94	7·02	8·46	4·43	18·16	12·05	12·12	6·6	3·66	7·44
G.S. M/L/3005	Dirty white	Sub-angular to angular	Trace	·40	43	0·0	0·04	2·94	20·50	33·41	38·26	2·70	1·32	0·14	0·0	·06
G.S. M/L/3015	White	Sub-angular	Small amount	*Nil*	52	0·0	0·0	1·4	13·0	17·6	47·6	12·6	6·6	0·8	0·1	0·1

REPORT ON THE GREAT FINGALL VENTURE 1949-50.

By J. C. McMath, B.Sc. (Hons. Lond.), F.G.S., M. Aust., I.M.M.

Introduction.

The Great Fingall Mine, operated by Messrs. Bewick Moreing & Co. from 1897 to 1918, when it closed down, is situated at Day Dawn, Murchison Goldfield, some 400 and 525 miles north of Perth by road and rail respectively. Over the period of its life the mine produced 1,875,365 tons of ore for a recovery of 1,216,579 fine ounces of gold from the Great Fingall Reef.

Brief Geological Background.

The ore-bodies, quartz reefs, occur in a series of folded Pre-Cambrian basic lavas and metasediments which have been intruded by one major dolerite sill together with sundry minor, and apparently concordant, doleritic bodies. These intrusive dolerites are pre-folding in age. The series has a high westerly dip and forms the western limb of a north plunging regional anticlinorium whose nose lies just north of Cue. The relevant rock succession, from east to west, is:—

Major dolerite sill.

Slates.

Basic lavas (with thin slate horizons and pillow lavas).

The payable reefs occur as quartz filling of tension fractures in the dolerite sill together with quartz replacement of the dolerite along these tension fractures. The sill strikes N.35°E. and has a westerly dip of 60°. Within the sill the payable ore-bodies strike approximately north-west and dip westwards at 60°. Gold mineralisation is post-folding in age and is localised by tension strains set up by warping of the major dolerite sill. These warps show some degree of correlation with slight "cross flexuring" in the regional structure[1].

Initiation of the Venture.

Ore search and the future life of the known goldfields of Western Australia now depend increasingly upon the large scale (and costly) application of advanced geological and geophysical techniques followed by diamond drilling of prospects so brought to light. There are two broad fields of such ore search—

(a) the close investigation of past major producing ore-bodies for the possibilities of repetition in depth;

(b) the close investigation of auriferous areas on a regional basis for favourable environments for the localisation of major ore-bodies.

These broad fields may—and often do—merge. The first field offers the more immediate prospects and, generally speaking, is the major field of present day activity.

[1] Ann. Prog. Rept. G.S.W.A., 1950—J. C. McMath.

In 1935 the Western Mining Corporation, Ltd. carried out such an investigation of the Day Dawn prospect, and their Chief Geologist—H. J. C. Conolly, A.R.S.M., B.Sc.—published brief results of his detailed analysis of structure and gold distribution in the Fingall ore-body together with deductions as to probable repetition of this ore-body in depth[2].

On 21st March, 1946, a formal request was made to the Under Secretary for Mines by Mr. Conolly (now in private practice as a consulting geologist) applying for "a temporary reserve of 300 acres or more covering, to a depth of 5,000 feet, the Great Fingall reef and also the three reef formations crossing the Great Fingall dyke to the south-west of this mine."[3]

This Day Dawn area was one of four abandoned mining districts which Mr. Conolly wished to explore. He stated tentative plans for financing these explorations—"£20,000 was earmarked as necessary for the Great Fingall test. Mr. Conolly emphasised that long range efficient and economical diamond drilling which had made deeper exploration practicable in U.S.A. and Canada was necessary with regard to the Great Fingall and other deeper prospects. Without this efficient and economic drilling performance nothing could be done."[4]

The Government Geologist, well knowing the need for encouraging deep exploration in the Goldfields, the need for structural geology in relation to ore search, the need for geological data from depth in critical locations of broad regional structure, and the high degree of geological probability for the repetition of the Fingall ore-body in depth, advised that this request be favourably considered by the Mines Department. The application was granted.

The introduction to Australia of the long range, etc., diamond drilling was effected through the organisation of a drilling company—under the style of Australian Drillers Pty., Ltd.—by a group of interested Eastern States mining companies. The purpose of this drilling company was to provide the modern equipment and expert drilling personnel necessary for this type of exploration.

The Great Fingall Exploration Company Ltd.

The situation at this stage is—

(a) a valid prospect of the repetition of the Fingall ore-body in depth;

(b) the creation of a temporary reserve protecting the prospect;

(c) the existence of Australian Drillers Pty. Ltd. to supply the drilling equipment, expert personnel and technique, without which such deep exploration was considered impracticable.

[2] "A Contour Method of Revealing Some Ore Structures"—H. J. C. Conolly. Econ. Geol., Vol. XXXI., No. 3, 1936.

[3] G.S.W.A. File 39/1946. "Boring Great Fingall and Three Reefs to South-West, Day Dawn"—letter H. J. C. Conolly to Under Secretary for Mines—21/3/1946.

[4] Op. cit.

It remained to finance the exploration. Accordingly, the Great Fingall Exploration Company Ltd.[5] was incorporated in W.A. under the Companies Act, 1943-47, on 18/2/1949. The main object of the company was to explore in depth the Great Fingall prospect recommended by its consulting geologist (and director) H. J. C. Conolly. This prospect was covered by Temporary Reserves 1231H and 1232H together with G.M.L. 672D—totalling 488 acres.

The financial structure of this company was as follows:—

1. Nominal capital, £500,000 in 2,000,000 shares of 5s. each.
2. Actual available fund—
   (a) £16,000 from public subscription;
   (b) £14,000 from Anglo-Westralian Mining Pty. Ltd.;
   (c) £10,000 loan from State Government.

It should be noted that the Government loan was repayable in full only in the event of payable ore-bodies being found. In the event of failure, on a liquidation of the company, Government could claim ten fortieths of the company's assets.

This loan was recommended to the Government by the Government Geologist for the reasons already set out, and was only so recommended by virtue of his firm belief in the availability of modern and efficient diamond drilling services through Australian Drillers Pty. Ltd. Again, it is emphasised, high calibre and economical deep drilling could only make the venture practicable. Briefly, the venture was sponsored[6] by the Government upon the recommendation of the Government Geologist in order to—

(a) demonstrate ore search in depth from the geological aspect;
(b) demonstrate modern drilling practice in deep exploration;
(c) encourage the search for potential ore bodies in existing gold-fields and thus prolong the lives of those fields and lend stability to the mining population;
(d) geological data from depth in a critical location on a broad regional structure.

The Government was not represented on the board of directors although, by invitation of the Company, the Government Geologist attended board meetings.

Anglo-Westralian Mining Pty. Ltd. were appointed managers of the project, and held the controlling interest in the project.

The operation, as per Prospectus, was to be carried out by four or more diamond drill holes planned by its consulting geologist. The drilling was to be carried out under contract with equipment and experienced personnel by Australian Drillers Pty. Ltd. To effect this, Great Fingall Exploration Company Ltd., through a £10,000 subscription, became a member of Australian Drillers Pty. Ltd. This left £25,000 of available funds allocated to actual exploration work.

State Government Assistance was rendered to the venture both in its gestatory and operational stages. The assistance took two forms:—

(a) Financial—the £10,000 loan has been previously remarked.
(b) Practical—i.e. Departmental work and facilities rendered were as follows:—
   (i) Preparations of a detailed geological plan, 1 inch = 100 ft.) of the relevant reserves together with the necessary field work by Mr. N. M. Gray of the Geological Survey.
   (ii) Preparations of gold contour plans of the Fingall Reef by Mr. Gray, under the direction of H. J. C. Conolly.
   (iii) Facilities offered in the preparation and reproduction of the above plans by the Mines Draughting Office.
   (iv) The secondment, on a part time basis, of the author to act as local geologist to the venture under the direction of and responsible to the Company's consulting geologist.

Operational Phase.—The situation of the venture was, then, at March, 1949, as follows:—

(i) Successful promotion of the Great Fingall Exploration Co. Ltd. to explore by diamond drilling, laid out by its consulting geologist, the Fingall Prospect.
(ii) Anglo-Westralian Mining Pty. Ltd. with headquarters at Big Bell, W.A., were appointed managers to the exploration company (in which they held a controlling interest) and undertook to render technical assistance and facilities in the field as occasion arose.
(iii) Australian Drillers Pty. Ltd., by virtue of a £10,000 subscription from the exploration company, were to provide modern equipment, experienced Canadian practitioners of up to date diamond drilling techniques (including directional drilling), and to carry out the drilling. The specific reason for the formation of this drilling organisation was to introduce efficient and economical deep diamond drilling techniques to Australia.

The Drilling Plan.—The prospect of repetition of the Fingall ore-body was estimated by H. J. C. Conolly to occur on the Company's Reserves within the vertical limits of 3000 and 3400 feet, with an overall target area approximately 950 ft. x 250 ft., the larger axis trending north-west.

It was proposed, vide Prospectus of the Great Fingall Exploration Company, to explore this prospect with "four or more diamond drill holes". Final planning of the exploration was made in February, 1949, and the "four or more diamond drill holes" concept was changed to two diamond drill holes now considered sufficient to cover the range of possibilities. After discussion with the Field Superintendent of Australian Drillers Pty. Ltd. (an expert practitioner of controlled diamond drilling)—the Fingall Exploration Company's consulting geologist decided that the exploration be initiated by a diamond drill hole controlled to vertical from which subsequent directional diversions would be made. The depth to the target lay between 3000 and 3400 ft. vertically and the order of magnitude of allowable creep of such a controlled vertical hole was given as an elipse 100 ft. long by 70 ft. across. In accordance with the location of the target, creep consideration, etc., No. 1 Diamond Drill Hole was sited N 85° 15'30" W. and 1465 ft. distant from the Armstrong Shaft. This shaft is the origin of the co-ordinate system used by the Geological Survey in the preparation of the detailed plans of the prospect. With reference to this origin, the co-ordinates of No. 1 D.D.H. were 121 ft. South, 1460 W.

Of this change from "four or more diamond drill holes" to one controlled to vertical with subsequent directional diversions, it is supposed that formal acceptance and ratification of this departure from the drilling proposal as set out in the Prospectus is to be found in the minutes of the Great Fingall Exploration Co.

Controlled Diamond Drilling.—The basic principle is that the direction and inclination of a diamond drill hole can be controlled by positioning a deflecting wedge (whipstock) in the hole. The technique, developed and perfected in oil-well drilling, has been extensively applied in Canada and America to Pre-Cambrian metaliferous ore-search. The success of the technique said to be achieved in Canada is at variance with the results of the Fingall venture. Australian Drillers Pty. Ltd. imported drilling experts, and it was understood experts in wedging, for the purpose of the Fingall operation. The detail of this wedging technique followed by this drilling company is given in a paper presented to the Annual Meeting of the Canadian Diamond Drilling Association by H. M. Brownall—Resident Geologist,

[5] Prospectus of the Great Fingall Exploration Co. Ltd.—18/2/49.
[6] *vide* Prospectus of Company.

Frood Mine (International Nickel Company of Canada). The paper is entitled "Controlling Dip and Direction of Drill Holes by the Hall-Rowe Wedging Method". The paper was read in June, 1949.

Directional wedging of a hole entails—

(i) survey of hole;

(ii) orientation and positioning of wedge in the hole;

(iii) check survey to ensure effectiveness of wedging operation.

The wedges employed in the Hall-Rowe Method are of brass or steel and remain fixed in the hole. Controlling a hole to vertical entails the same stages as above but is, theoretically more simple—orientation of the wedge being automatically determined by the drillers' use of the acid clinometer. It is remarked that, on the Fingall operation, a meniscus correction chart was supplied to the drillers. No accurate goniometer for reading the angle of inclination of the etched line was supplied. This was done with a home-made piece of apparatus of debatable value. In view of this the uses of the correction chart remain unknown.

For an accurate appreciation of the course of the hole survey both in azimuth and inclination the Trotter-Pajari Compass (supplied by Australian Drillers Pty. Ltd.) was used. Some comments on the three instruments used at various times are not out of place. Both sizes of instrument—BX/NX and EX/AX—were used and found unsatisfactory. Briefly, the instrument is ideal in concept. It is, however, liable to certain operational difficulties which can vary. These are largely attributed to unsound standards of manufacture and are centred about—

(i) imperfections in timing gear leading to premature withdrawal of the instrument from the hole;

(ii) uncertainty of effectiveness of locking device operated by timing gear under rod vibration, etc. during withdrawal of instrument from the hole.

Two BX/NX Troparis were found at fault and unserviceable. The EX/AX Tropari was found in error in time calibration but otherwise serviceable. Even if perfect, these instruments do not obviate the hazards of bore-hole survey since determination of azimuth is dependent upon a magnetic needle. The course of D.D.H. No. 1 hole was plotted in plan projection and creep studies made—reference Appendix I. Creep studies were also made of D.D.H. No. 2—reference Appendix I.

Plant and Equipment.—The drill supplied for the job was a Boyles Bros. B.B.S. No. 4, powered by a G.M.C. 248 truck engine with five speed transmission. Maximum performance with B rods 5,000'—with N rods 4,000'. The machine had chuck jaws modified to take B rods.

The tower used consisted of Cyclone Tubular Steel Scaffolding of overall height 80 ft.—78 ft. to distributing beam. Total weight was approximately three tons.

Circulating water was drawn from the St. Alban's Shaft.

Personnel.—Two Canadian driller-runners and two Australian helpers (trainee runners). Work was, for the greater part of the time on D.D.H. No. 1, on a three shift per 24 hour basis and a five day drilling week. The Field Superintendent, Mr. McCabe, was present at the start of drilling. The dates of his subsequent visits are not known to the author.

Diamond Drill Hole No. 1.

Co-ordinates (origin Armstrong Shaft) of collar were 121 ft. S., 1460 ft. W. Direction of hole was to be vertical and maximum permissible inclination before wedging back to vertical was laid down as 3°. The corrective value of a wedge was 1½°. Size of Core—BX = 1⅝ inches.

Drilling started on 12th December, 1949, and continued until the abandonment of the hole on 6th July, 1950, at a vertical depth of 1130 ft. The abandonment of the hole—which had become mechanically unsound as a result of loosened wedges, dog-legging, and rod whip, was forced on the Company's Consultant by the failure of the drillers to pull the existing casing preparatory to re-casing to 1,000 ft. approximately. Until this point, completion of the hole considered practicable if the casing could be carried to 1,000 ft.

This mechanical condition of the hole existed in March, 1950, when the Company's Consultant visited the site. Thus, the overall drilling performance was of the order of 160ft. per month. It is remarked that the Consulting Geologist in a report to the Great Fingall Exploration Company dated 8th March, 1950 (after his visit to the site) said "it is reasonable therefore to look for, in the controlled drilling at Fingall, speeds in the order of 400ft. per month down to a depth of 2,000ft. Below 2,000ft. the rate will be progressively retarded to say 200ft. per month." At the time of this report, the drilling speed had been of the order of 300ft. per month.

This overall performance, not in accord with initial estimates of time and cost, was occasioned by the following factors:—

(i) Initial equipment difficulties, time spent "fudging a course" whilst awaiting arrival of items, and the need for modication or re-machining of accessories supplied.

(ii) Failure of wedging operations through "turning" of the wedge during setting. Turning of wedges was ascribed to—

(a) rosing off collar of wedge with worn rosing bits;

(b) an unsound wedging base due to acumulation of sludge, cuttings, and caved material in the bottom of the hole. (A clean base is essential to successful wedging).

In the case of such abortive wedges, it was necessary to back up the hole and re-wedge, resulting in lost footage and time.

(iii) Losses of circulating water and consequent build up of sludge, etc. in the bottom of the hole. It was necessary to cement the horizons at which these losses occurred.

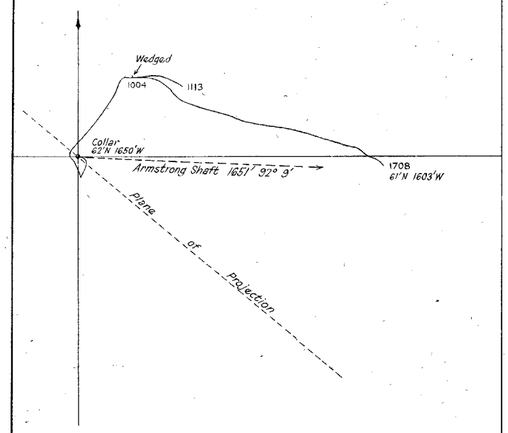
(iv) Salinity of water accumulating in the hole leading to failure of cement, experimentation with cement mixtures—Cement Fondu and Portland—with a cartridge of Cement Fondu and bentonite finally giving a measure of success. A water analysis by the Government Chemical Laboratory showed that water at 750 ft. had a salinity of over 7,000 grains per gallon and that considerable calcium and magnesium ions were present. To overcome this, casing was carried down to 390ft.

So much for the general history of the drilling operations. In all 18 wedges were set, nine proving abortive for various reasons, of which "turning" was the chief. This was followed, in order, by the failure of wedges (though correctly positioned) to materially reduce the creep. Lastly two wedges jammed whilst lowering.

On 24th May, the Boyle Bros. B.B.S. No. 4 Drill was withdrawn by Australian Drillers Pty. Ltd. from Fingall and shipped to the Eastern States for service on a further Conolly prospect. Its place was taken by a Longyear Master Straightline Drill hired from the Commonwealth Government. The rating of this machine was 4,250ft. with A rods and 3,250ft. with B rods. It was said that this Longyear machine was suited to Fingall requirements.

Throughout the operation core recovery was high (approx. 98 per cent.) Reference may be made to Appendix II for the core record. A diagram showing the present condition of the hole constitutes Appendix III.

The author, by reason of urgent geological commitments elsewhere, was withdrawn from the venture on 4th May, 1950, by the Mines Department.



Plan Projection of D.D.H No 2 from plan supplied by Anglo-Westralian Mining Pty Ltd

"Ex" TROPARI SURVEY ANALYSES

DEPTH	INCLINATION	DEPARTURE OR CREEP	PROGRESSIVE CREEP	AZIMUTH	
0-50'	89½°	0·4'	0·4'		
50-100	89°	0·9	1·3	S81°W	
100-150	88½°	1·3	2·6	S87°W	
150-200	87°	2·6	5·2	S6°E	
200-250	87°	2·6	7·8	S17°E	
250-300	88½°	1·3	9·1	S46°W	
300-350	88°	1·7	10·8	S20°W	
350-400	87½°	2·2	13·0	S5°E	
400-450	87°	2·6	15·6	S7°W	
450-500	87°	2·6	18·2	S20°W	
500-550	87°	2·6	20·8	S6°W	
550-600	86°	3·5	24·3	S54°W	
600-650	88°	1·7	26·0	S39°E	
650-700	87°	2·6	28·6	S34°E	
700-750	86°	3·5	32·1	S71°E	
750-800	87°	2·6	34·7	S71°E	
800-850	85°	4·4	39·1	N87½°E	Based on "Ex" Tropari surveys by Anglo-Westralian
850-900	85°	4·4	43·5	N75°E	
900-950	86½°	3·5	47·0	N45°E	
950-1000	86°	3·5	50·5	N74°E	

D.D.H Nº1 AT 800'

R.L. depth 799·2'

Co-ordinates of hole 121'S 1460'W
+256 -1
1466'S 1458'W

Creep tendency S 2°E.

Average rate of creep per 100 ft. depth = 4·3 ft

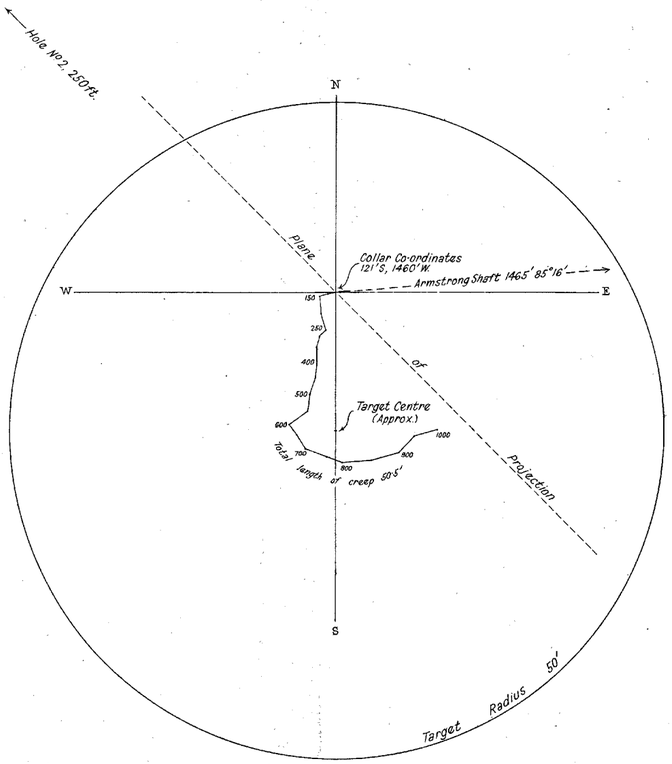
D.D.H. Nº1 AT 1000'

R.L. depth 998·7'

Co-ordinates of hole 121'S 1460'W
+208 -18·4
1418'S 1441·6'W

Creep tendency S 37°E

Average rate of creep per 100 ft = 5 ft.



PLAN PROJECTION D.D.H. Nº1

FIGURE 2

CREEP STUDY

of

GREAT FINGALL D.D.H. Nº 1

Scale 1 inch = 20 feet

Compiled by J.C McMath, Dec. 1950

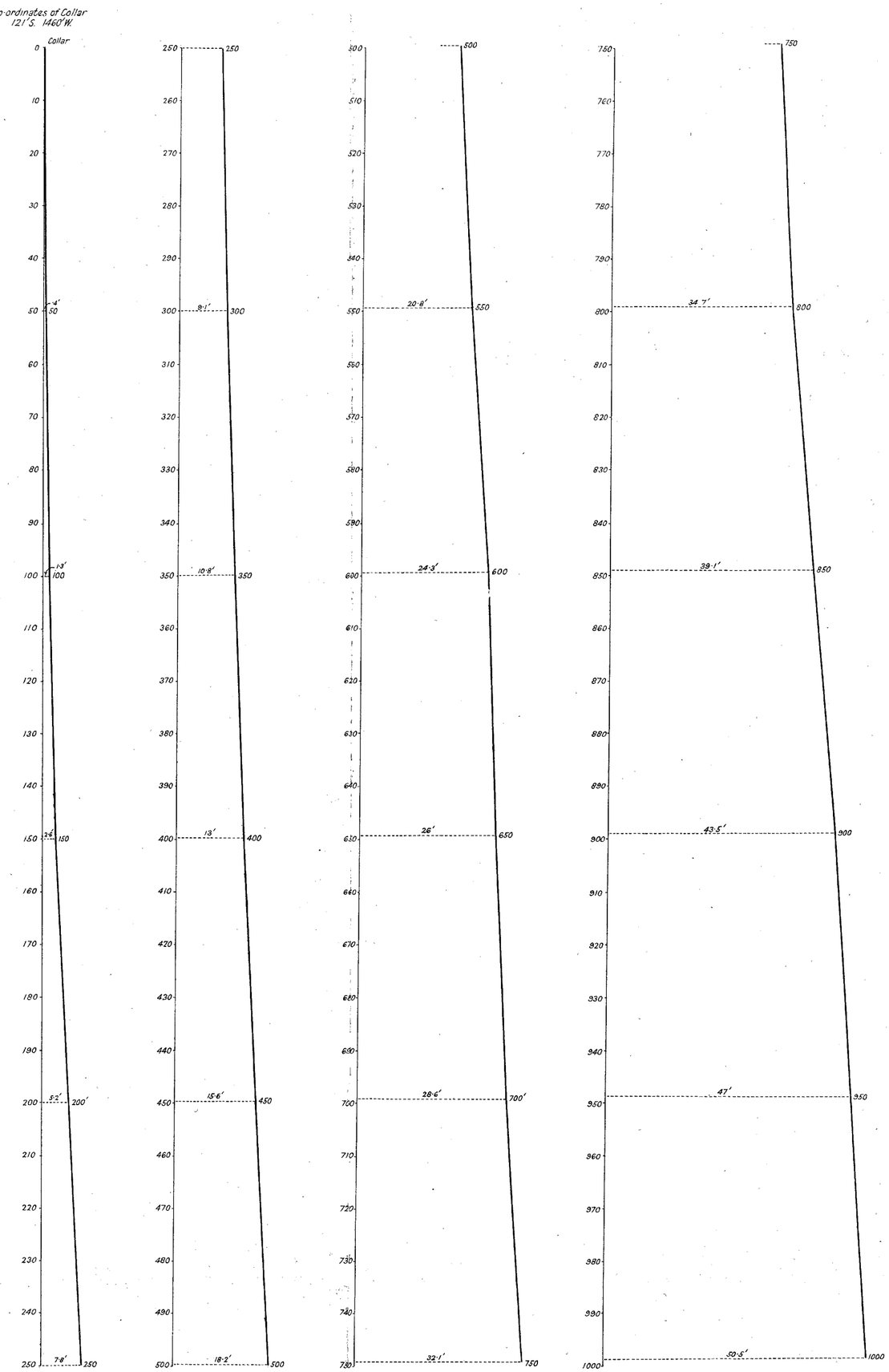
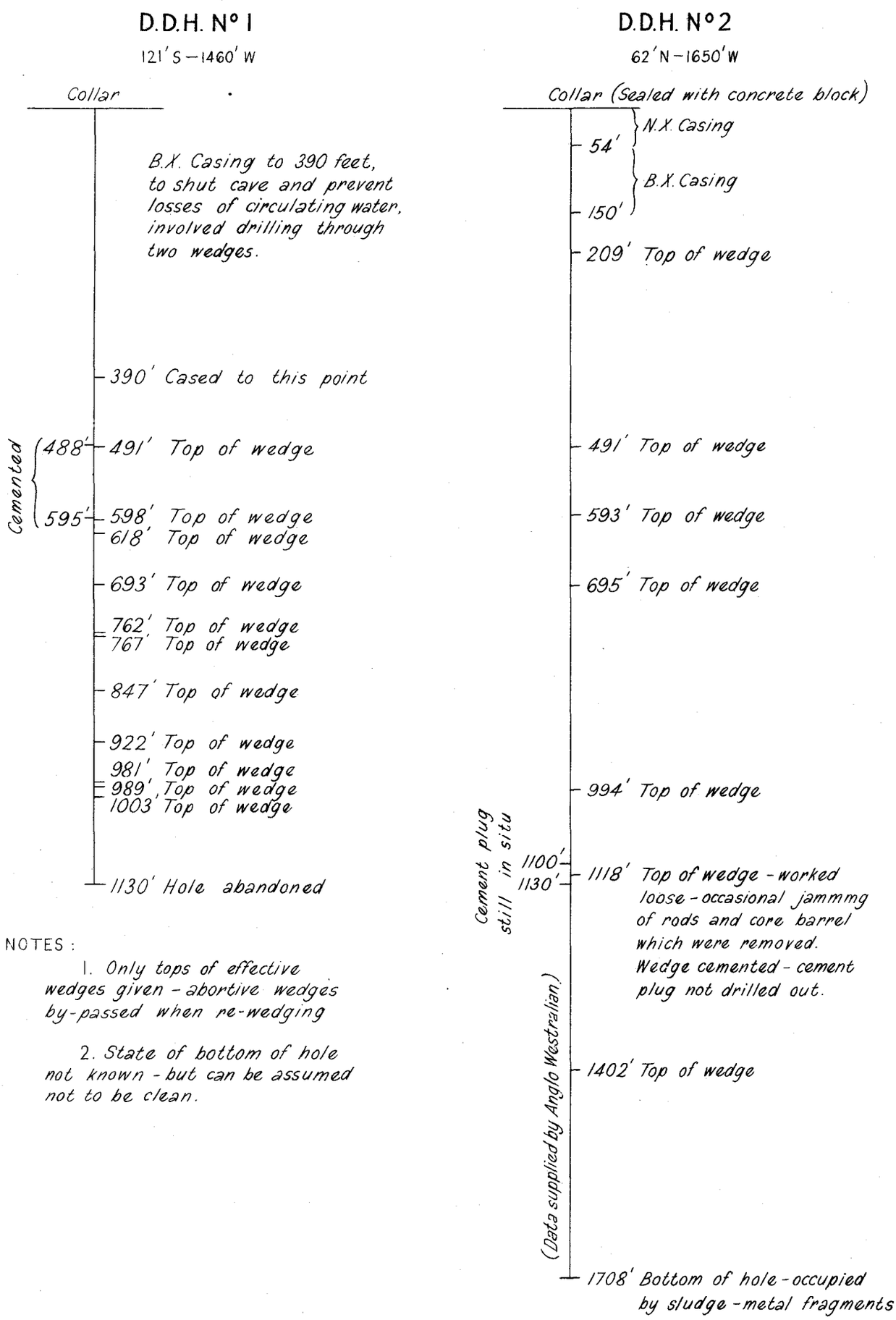


FIGURE 3

CONDITION DIAGRAM OF D.D.H. NOS 1 & 2

Co-ordinate Origin - Armstrong Shaft
Core Size - B.X. - 1⅝"
Direction - Vertical
Scale: 200 feet to an Inch



NOTES:

1. Only tops of effective wedges given - abortive wedges by-passed when re-wedging

2. State of bottom of hole not known - but can be assumed not to be clean.

W.R.M.

J. McMath 21. 12. 50.

Prelude to Diamond Drill Hole No. 2.

The foregoing operations had made inroads into the available funds of the Great Fingall Exploration Company. After visiting the site in early July, 1950, the Company's Consultant in a report to the Company (dated 9th July, 1950) remarks—"The project has been well nigh wrecked by the failure of the drillers to put down, under Australian conditions, a controlled hole. It has become necessary to abandon the hole preparatory to setting up on a second hole which must, without fail—

(a) hit the target;

(b) be completed with the money that is left.

After summarising his reasons, he recommended a second hole—again controlled to vertical but making allowance for the overall residual creep experienced in D.D.H. No. 1. The length of the hole was to approximate 3,500ft. at a total cost of £15,000. He adds "Mr. McCabe (Field Superintendent, Australian Drillers Pty. Ltd.) has assured the Great Fingall Co. the Longyear machine will do the job as indeed it will by its rated capacity."

Diamond Drill Hole No. 2.

Co-ordinates were (Armstrong Shaft origin) 62ft. N. 1,650ft. west—i.e. 250ft. north-west of D.D.H. No. 1.

Direction of hole was to be vertical with maximum permissible inclination before wedging of 2° and a minimum wedge interval of 100ft.

The target was substantially that of D.D.H. No. 1.

Drilling was started on 24th July, 1950, and finally suspended at a depth of 1,708ft. on 13th November, 1950, due to the financial straits of the Great Fingall Exploration Company. The overall drilling rate was of the order of 400ft. per month—a very marked difference from performance on D.D.H. No. 1. Apart from poor mechanical performance of the Longyear machine and ancillary units, the history of the hole is uneventful apart from normal drilling "grief"—no water troubles were encountered, the Tropari Compass and container were dropped down the hole accidentally, the bit jammed against a loose wedge at 1,118ft. Eight wedges in all were set, one only proving abortive due to not seating properly. The wedge at 1,129ft. became loose and the latter part of operations was centred about this trouble. The condition of the hole at the close down on 13th November, 1950, was that the hole had been cemented from 1,100ft.-1,130ft. to secure the loose wedge seated at 1,129ft. The cement plug was left in the hole. The bottom of the hole was not cleaned of sludge, metal cuttings, etc. The collar of the hole was securely covered by a cement block. Local supervision of operations was carried out by Anglo-Westralian Mining Pty. Ltd.

Core recovery and log was substantially the same as for D.D.H. No. 1 (Ref. Appendix III). The creep study, by courtesy of Anglo-Westralian Mining Pty. Ltd., appears together with that for D.D.H. No. 1 in Appendix I. A diagram showing the present condition of D.D.H. No. 2 appears in Appendix II.

Financial Exhaustion of Venture.

At a General Public Meeting of the Great Fingall Exploration Company on 21st September, 1950, the financial position as given by the Secretary was that, with all cash resources marshalled, including the full £10,000 loan from the Mines Department, they had £6,300. The estimate for the completion of the second hole to the first intersection was £17,000 approximately. Drilling was suspended temporarily pending arrangement for the provision of further capital. Approaches for temporary assistance were made to Australian Drillers Pty. Ltd., but such accommodation was not forthcoming. At a meeting of directors held on 28th September, 1950, a further proposal was advanced and, pending its finalisation, it was agreed that drilling be continued until the first week in November, when a further meeting would be held to review the position.

A further meeting of directors of Great Fingall Exploration Company was held on 3rd November, 1950. It then appeared that the proposed financial arrangement adumbrated at the meeting of 28th September, had fallen through completely for reasons appreciated by all concerned. It appeared, also, that the Company's Consulting Geologist was now uncertain, in the light of experience at Cobar and Mt. Lyell as well as at Fingall, whether deep drilling, practicable in Sudbury, was impracticable in Australia. It was decided to suspend drilling at Fingall and continue to endeavour to obtain additional finance. Accordingly, drilling was stopped, machine and rig dismantled, crew dispersed, the hole left sealed and the Great Fingall project reduced to suspended animation.

No comment on the history of the venture is necessary beyond that the repetition of the Fingall ore-body in depth remains a very legitimate prospect awaiting a more advanced drilling technique and financial appreciation than those used in the first approach to the problem.

References.

Bull. No. 7, G.S.W.A. 1903—Auriferous Reefs of Cue and Day Dawn.—W. D. Campbell.

Bull. No. 29, G.S.W.A.—1907—A Report upon the Geology, together with a description of the Productive Mines of the Cue and Day Dawn Districts, Murchison G.F. Pt. 1.—H. P. Woodward.

Ann. Prog. Rept. G.S.W.A. 1950—A Reconnaissance Survey of the Cue-Day Dawn Districts, Murchison G.F.—J. C. McMath.

Econ. Geology Vol. XXXI. No. 3, 1936, "A Contour Method of Revealing Some Ore Structures."—H. J. C. Conolly.

G.S.W.A. File 39/446, "Boring Great Fingall and three reefs to South-West, Day Dawn."—H. J. C. Conolly.

G.S.W.A. File 14/1949—Great Fingall Exploration Co.—General.

APPENDIX.

GREAT FINGALL VENTURE.

Logs of D.D.H. No. 1 and D.D.H. No. 2.

D.D.H. No. 1.

Depth (feet)	Remarks.
0 - 2	"Cement" and red clay.
2 - 55	Fine grained basic lavas—small quartz veinlets—a fracture system inclined approx. 30° to core axis. Varying degrees of weathering to approx. 40ft., thereafter fresh, dark green coloured basic lavas with some decomposition along fractured planes. Occasional small cavities infilled with limonite—? pseudomorphous after sulphide. Interval 53'-55' shows basic lavas with amphibole phenocrysts—? flow top.
55 - 56	Bleached compact ? tuff band.
56 - 128	Compact fine grained basic lavas with previous characteristics. Limonite and a little calcite on joint planes. Occasional limonite pseudomorphs after pyrite.
128 - 133	Fine grained basic lavas with quartz veinlets, following fractures at 30° to core axis. Basic lavas are slightly silicified.
133 - 134	White quartz at 30° to core axis—carrying xenoliths of fine grained basic lavas. Walls show dilation veinlets of quartz.
134 - 135	Fine grained basic lavas, slightly silicified. Slight amount of sulphide—? pyrrhotite.
135 - 139½	White quartz with basic lava xenoliths. No visible mineral in quartz.

D.D.H. No. 1.

Depth (feet)	Remarks.
139½- 250	Fine grained basic lavas—disseminated and sparse sulphide. Quartz stringers (at 30° to core axis) show slight sulphide. Basic lavas closely jointed with thin quartz films in joint planes. Quartz stringers tend to anastomose, the master veins being at 30° to core axis. Occasional vesicular and brecciated bands sub-parallel to core axis—? selvages of pillows.
250 - 273	Medium grained basic lavas—sparse sulphides—quartz veinlets at 30° to core axis. Some silicification. Possibly a doleritic minor intrusive. Sludges 250'-260' gave 0.5 dwts.—260'-270' gave 0.3 dwts.
273 - 293	Fine grained basic lavas with quartz veins at 30° to axis of core, also to plane of core diameter.
294 - 324	Medium grained basic lavas with quartz veinlets—possible doleritic minor intrusives. Sludges from 310'-320' assayed 0.3 dwts.
324 - 376	Fine grained basic lavas—slightly silicified—quartz veinlets at 30° to core axis. Sparse sulphides, with a heavier concentration at 329'. Some brecciation and "pillow" selvage features. Some selvage features show glassy tendency. These lavas become carbonated at 372' and break in blocky fashion.
376 - 467	Medium grained basic lavas. Quartz veins at 30° to core axis. Sparse sulphides.
467 - 557⅝	Fine grained basic lavas with pillow selvage features, quartz veinlets, sparse sulphides.
557⅝- 558	Quartz vein at 30° to core axis.
558 - 570½	Fine grained basic lavas—sparse sulphides—quartz veinlets at 30° to core axis cut by later set at 20° to core axis.
570½- 571½	Quartz vein at 30° to core axis.
571½- 573½	Fine grained, compact basic lavas.
573½- 574	Quartz vein at 30° to core axis.
574 - 579½	Fine to medium grained basic lavas —with quartz veinlets.
579½- 581½	Quartz vein in fine grained basic lavas.
581½- 606½	Fine grained basic lavas—quartz veinlets to 30° to core axis—cleaved at 30° core axis. Sparse sulphide.
606½- 609	Quartz vein and brecciated fine grained basic lavas.
609 - 613½	Compact fine grained basic lavas.
613½- 614	Quartz at 30° core axis.
614 - 808	Fine grained basic lavas—sparse sulphides—quartz veinlets at 30° to axis of core. Cleavage 30° to axis of core. Occasional fine brecciation and pillow selvage features. Quartz veinlets occasionally show megascopic sulphide. Shearing of lavas becoming more pronounced at 763'. Increase of sulphide from 763'-808'.
808 - 808½	Quartz vein at 30° to core axis—carries schlieren of slate.
808½- 810½	Black slates—sparse sulphides—quartz veinlets—cleavage is 30° to core axis.
810½- 814½	Quartz reef at 30° to core axis—sparse sulphides—slate inclusions.
814½- 817	Fine grained, silicified, basic lavas—sheared, with quartz veinlets, at 30° to core axis. Sparse sulphides.

D.D.H. No. 1.

Depth (feet)	Remarks.
817 - 824	Black slates, sparse sulphides, quartz veinlets. Cleavage is 30° to axis of core.
824 - 839	Silicified fine grained basic lavas—sparse sulphides—sheared at 30° core axis. Quartz shows sulphides.
839 - 841	Quartz with slate inclusions—megascopic sulphide.
841 - 845	Black, brecciated slate and quartz—sulphides present.
845 - 854	Fine grained basic lavas—quartz veinlets at 30° to core axis. Sparse sulphides.
854 - 863	Black slates, showing bedding of dip approx. 65°. Quartz veinlets and sparse sulphides.
863 - 866	Fine grained basic lavas with quartz veinlets.
866 - 878	Black slates—silicified—bedding shown. Quartz veinlets and sparse sulphides.
878 -1130	Fine grained basic lavas, quartz veinlets, sparse sulphides (arsenopyrite)—fractures at 30° to core axis.
	Note.—Dips seen on surface are 70° approx. at N.62°W.

D.D.H. No. 2.

0 -1170	Substantially the same as for D.D.H. No. 1.
1170 -1300	Fine grained basic to intermediate lavas, with minor quartz stringers.
1300 -1499	Fine to medium grained lavas.
1499 -1505	Sheared lavas and black slate bands, 1502'-1505', banding inclined at 30°-45° to core axis.
1505 -1628	Fine to medium grained lavas.
1628 -1665	Medium to coarse grained lavas.
1665 -1676	Sheared lavas and thin bands of black slate, inclined 30°-45° to core axis.
1676 -1708	Fine to medium grained lavas.

PROGRESS REPORT ON DIAMOND DRILLING, COLLIE MINERAL FIELD, W.A.

No. 1. Site C—M.L. 415, North East of Shotts.

By J. H. Lord, B.Sc., F.G.S.

CONTENTS.

Introduction.

Although the deep drilling of the Collie Mineral Field has been recommended by various persons and bodies since 1905, it was not until the recommendation from the Geophysical and Geological Survey of Collie in 1946 and 1947 for deep holes at specified positions, that the Government decided to implement a deep drilling programme for the field.

The plant, which has been assembled by the Geological Survey of W.A., is being operated by Australian Drillers Pty. Ltd. as operating contractors using Canadian drill-runners.

Due to war-caused shortages, difficulties experienced in obtaining equipment from U.S.A. and lack of experienced drillers, it has taken considerable time to implement the project. Although the drill-

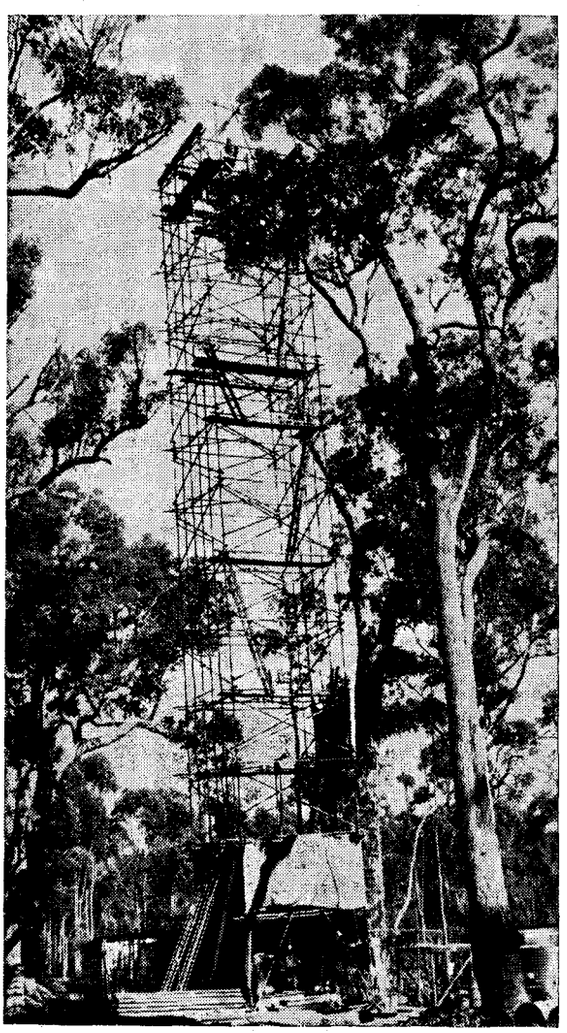
ing was authorised at the beginning of 1948, operations did not commence at Collie until 16th January, 1950.

This report details the results of the first hole drilled; a similar progress report, omitting some general details will be prepared after the completion of each hole.

Drilling Procedure.

The drilling machine, which was purchased from Boyles Bros., Canada, is their BBS-4 model powered by a G.M.C. petrol motor and capable of drilling a hole, using NX equipment, to a depth of 4,000 feet. Although NX size rods, etc., are being used, the core barrels are of NM size (produces a 1 27/32 inch diameter core) to permit the circulation of the drilling mud.

After the plant was set on bed logs, a 82-foot tubular steel tower was erected which permits the drilling rods to be pulled and broken in 60-foot lengths and greatly speeds up the raising and lowering of the rods. The photograph (Plate II.) shows this tower rising through the jarrah trees.



Owing to the soft nature of the coal measures, the Canadian drillers recommended drilling with bentonite mud. The bentonite mud has the property of forming a gel when allowed to stand; in consequence mud circulated through the drill, instead of water, penetrates the soft walls of the hole, gels and holds up the wall and thus prevents loss by seepage and caving. Also the mud, due to its viscosity and gelling properties, removes the cuttings from the hole and retards any rapid settling if circulation stops.

At Collie the mud was mixed with a nozzle-type mixer, and normally 700 gallons were mixed in each batch and run into a small mud sump. The bore water used, with a pH of 5, was too acid to mix a good mud. It was found that a more satisfactory mud, which did not allow settling when the hole was left for a short period, was made by increasing the pH to 10, using soda ash.

Collie has always been noted for its hazardous casing conditions and in the majority of deep holes much casing was lost. In this hole 13 feet of 4-inch pipe and three 10-foot lengths of NX casing was inserted and then drilling continued with mud fluid. The only difficulty experienced with the hole occurred when the NX casing unscrewed, so to avoid a recurrence it was removed.

This is the first hole in Australia which has been drilled using mud throughout, and it proved entirely successful in solving the problem of casing at Collie.

Wyoming bentonite was used at the rate of 7.2 pounds per foot compared with the usual estimated rate of four pounds per foot, this being attributed to the soft nature of the strata and to the problem mentioned below which resulted in much mud being lost.

The high viscosity of the mud, which was necessary owing to the soft nature of the strata, produced a problem, as the cuttings would not settle out despite settling ditches. This accounted for nearly all the lost time. The sandy nature of the cuttings rapidly wore the working parts of the mud pump, causing the breakdown of the circulation.

A "Shale Shaker," used for separating the cuttings from the mud, has been ordered and may be available for the next hole.

No trouble was experienced at any stage with underground water.

Twelve diamond bits were used in the hole, that is, one bit per 156 feet of drilling. The sandy nature of the strata caused the setting holding the diamonds to wear away, while there was very little actual diamond wear.

Two shifts were worked until the last week of drilling, when the third shift commenced. When drilling, each shift consists of a Canadian driller-runner with an Australian helper. The following table (Table I) sets out the manner in which the shifts (regardless of number of men employed) and man-shifts were distributed over the various operations.

TABLE I.

Time Distribution at Site C.

Operation.	Shifts.		Man-Shifts.	
	Number.	Percentage.	Number.	Percentage.
Drilling	124	71	254	59
Mud Mixing, breakdowns, etc.	23	13	55	13
Maintenance	8	5	24	5
Setting-up of Plant	20	11	101	23

These figures show that a drill of this size should be used only on deep holes, because 23% of the man-shifts worked were in setting-up and preparing the drill site.

The following table (Table II) is a study of the operations on the shifts, when drilling took place.

TABLE II.

Time Distribution While Drilling and Core Recovery.

Driller.	Number of Shifts Drilling.	Total Footage Drilled.	Core Recovered.	Footage Drilled per Shifts.	Percentage Core covered.
Irwin	62	898	514	14·6	57
Koski	59	931	515	15·8	55
Miscellaneous	3	43	25	....	....
Total	124	1,872	1,054	15·1	56

The average rate of drilling was 15.1 feet per shift, but the rate per man-shift for the whole operation was only 4.3 feet.

The erection of the plant began at Collie on 16th January 1950, and the hole was completed on 30th May 1950.

This is the deepest hole (1,872 feet) drilled at Collie to date, the previous deepest being the Municipal water bore to 1,134 feet. The estimated depth of this hole published previously was 3,000 feet by Geophysical means[19] and 1,900 by Geological means[20].

Core Recovery and Log.

As shown in Table II the overall total core recovery was 56 per cent. Fig. 4 shows the amount of core recovered for each 50 feet drilled. The only section where 100 per cent. core recovery was achieved was in the last 22 feet which was mainly granite.

In brief, it can be stated that coal and the darker shales cored reasonably well, but the soft sandy shales and soft sandstones were difficult to core. The graph of the core recovery (Fig. 4.) shows that there was only a very slight tendency for the sediments to become more consolidated with increase of depth.

Various methods of drilling were adopted to endeavour to obtain a better core recovery but none was successful. It is thought that, when the sandy cutings can be taken out of the mud with the Shale Shaker, core recovery may improve.

Published with this report (Appendix I) is a summarised log showing sediments and coal (three inches in thickness and over) intersected. A full detailed log has also been prepared and is available at the Geological Survey. The core was logged shortly after it was recovered, and since drying out the shales in most cases have taken on a darker tone of grey. Also in the logging there is a very fine distinction between sandy shale and shaley sandstone; in fact all could be termed shaley sandstone.

Probably, the most noteworthy feature of the core from the coal measures is the violent current-bedding, which occurs at places throughout. Small faults and slumps can be seen and, in one piece of shale, the core had a vertical "sandstone dyke" half an inch wide in it.

The violent sudden changes, which must have taken place during sedimentation are another notable feature. Frequently a fraction of an inch of shale in coarse-grained sandstone is shown in the core, while abrupt changes from coarse-grained sandstone to shale and vice versa are common.

The log was a field determination and representative samples are being forwarded to the Bureau of Mineral Resources for a more detailed investigation.

Geology.

This hole on Lease 415 (Fig. 5.) was drilled on a site recommended by the Geophysical and Geological Survey as being near the centre of one of the two depressions in the floor of the North-East Basin. It is interesting to note that this site is in granite on plans of the coalfield issued before the above survey.

A columnar section (Fig. 6.) shows all coal seams (three inches and over) intersected. The first seams cut were those of the Premier Horizon as described previously by the writer[21]. The following Table III. shows the evidence for classifying these seams as the Premier Horizon.

Between the Premier Horizon, which may be considered to end below the No. 6 seam, that is, at 400 feet, and the next horizon, to be described below, at 1,500 feet there occurs only five seams, with a thickness greater than three feet. The thickest is 5 ft. 4 in. but has a four inch shale band three feet from the top.

TABLE III.

Premier Horizon.

Stratigraphical Column.	Thickness in Diamond Drill at Site C.	Average Thickness in Percussion Holes on P.A. 53.	Thickness in Premier Caylx Bore.
	ft. in. ft.	ft. in. ft.	ft. in. ft.
No. 1 Seam	2 3	3 4	3 0
Sediments between No. 1 and 2 Seams	113	116	117
No. 2 Seam	4 7(signs of grinding)	5 10	6 0
Sediments between No. 2 and 3 Seams	40	30	54
No. 3 Seam	4 0(signs of intense grinding)	5 11	5 4
Sediments between No. 3 and 4 Seams	10	12	15
No. 4 Seam	7 0	6 6	6 4
Sediments between No. 4 and 5 Seams	144	170	171
No. 5 Seam	3 4	4 0	4 0
Sediments between No. 5 and 6 Seams	5	11	12
No. 6 Seam	3 10	5 0	5 0

It was in the above report on P.A. 53 that the writer suggested the possibility of intersecting the Ewington Horizon some 1,000 feet below the Premier Horizon. This proved to be approximately correct as three seams were intersected which are correlated with the Ewington Horizon, which in turn can be correlated with the Collie Horizon of the Main Basin. The seams were as follows:—

No. 1 (top) seam—12ft. 9in. of coal at 1,499 feet—equivalent to the Moira Seam of the Main Basin.

No. 2 (middle) seam—2ft. 2in. and 4ft. 7in. of coal separated by 1ft. 2in. of shale at 1,565½ feet—equivalent to the Dirty Seam of the Main Basin.

Note:—There was intense grinding in this coal and the seams were probably 3ft. and 6ft.

No. 3 (bottom) seam—8ft. 9in. of coal at 1,601½ feet—equivalent to the Wallsend or Proprietary seam of the Main Basin.

The blind outcrop of these seams is in the vicinity of Lease 324 at Ewington some six miles to the west-North-west of this bore. The amount of coal available between this bore and the outcrop will approach a hundred million tons, but no estimate of tonnage will be made until the deep drilling programme at Collie is completed and the whole of the evidence can be considered.

The drill after passing through approximately 50 feet of grey shale (mudstone to be more accurate) containing in places some sand and granite pebbles, entered a coarse-grained granite at 1,857 feet. The drill continued 15 feet into the granite to ensure that it was not merely a boulder. There was no zone of weathering on the granite, the change being sharp from Permian mudstone to fresh granite.

Quality of the Coal.

The details of the analyses carried out on samples submitted to the W.A. Government Chemical Laboratories are shown on Table IV. The Laboratories intend to carry out further work on selected samples later.

The coal did not vary to any extent from the usual quality of the Collie coal. The deep coal is not a coking or gassing coal as was suggested previously by some persons.

[19] CHAMBERLAIN, N. G.: Preliminary Report on the Geophysical Survey of the Collie Coal Basin. Bureau of Mineral Resources, Geophysical Report No. 1, 1948, p. 5 (hole C).

[20] LORD, J. H.: Necessity for Deep Bores at Collie, W.A. G.S.W.A. Ann. Rept., 1947, p. 21 (hole No. 3).

[21] LORD, J. H.: Report on Prospecting Area 53 at Collie, W.A.

Fig. 4 DIAMOND DRILL HOLE Nº 1 — SITE C
PERCENTAGE CORE RECOVERY

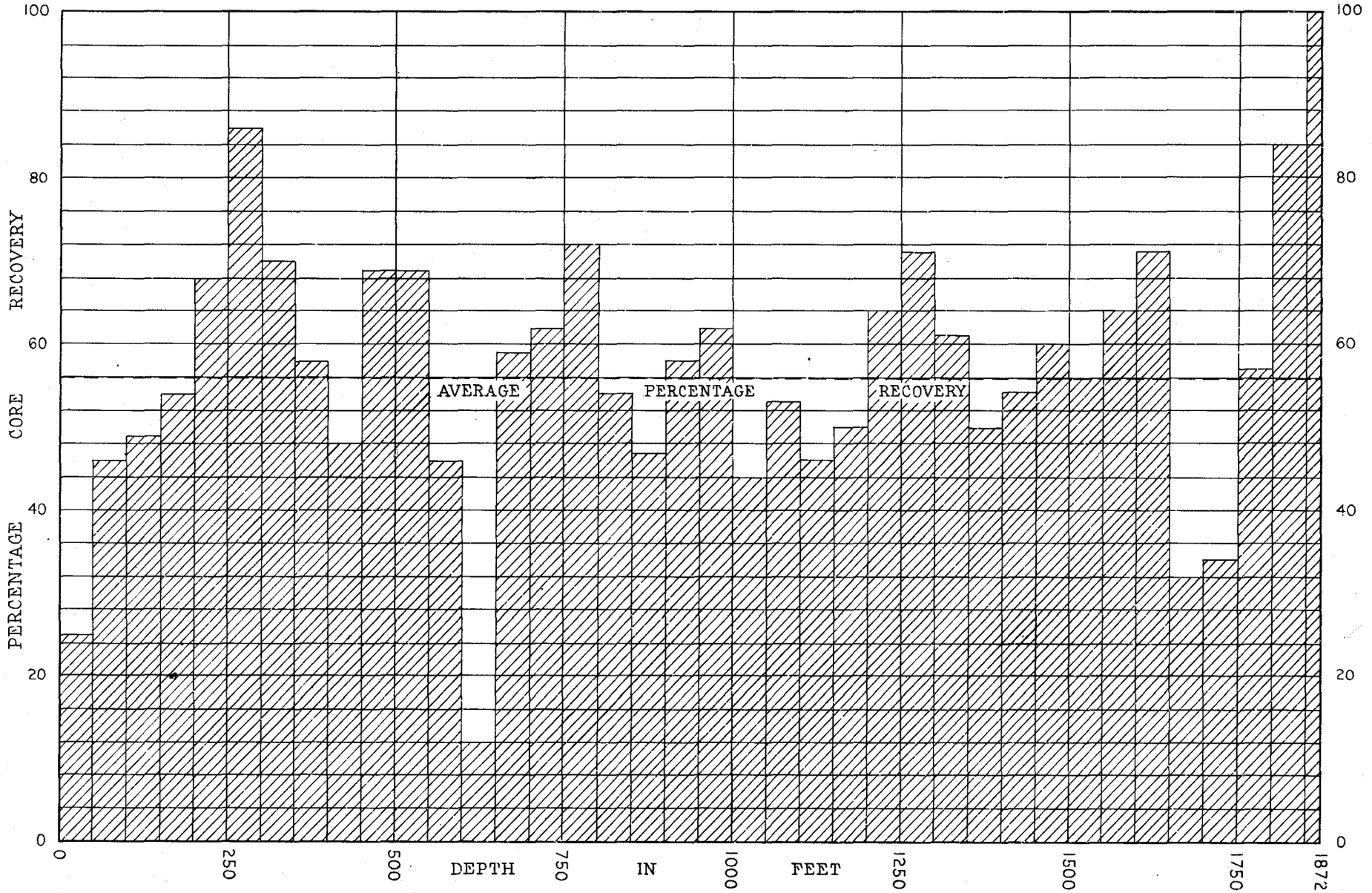
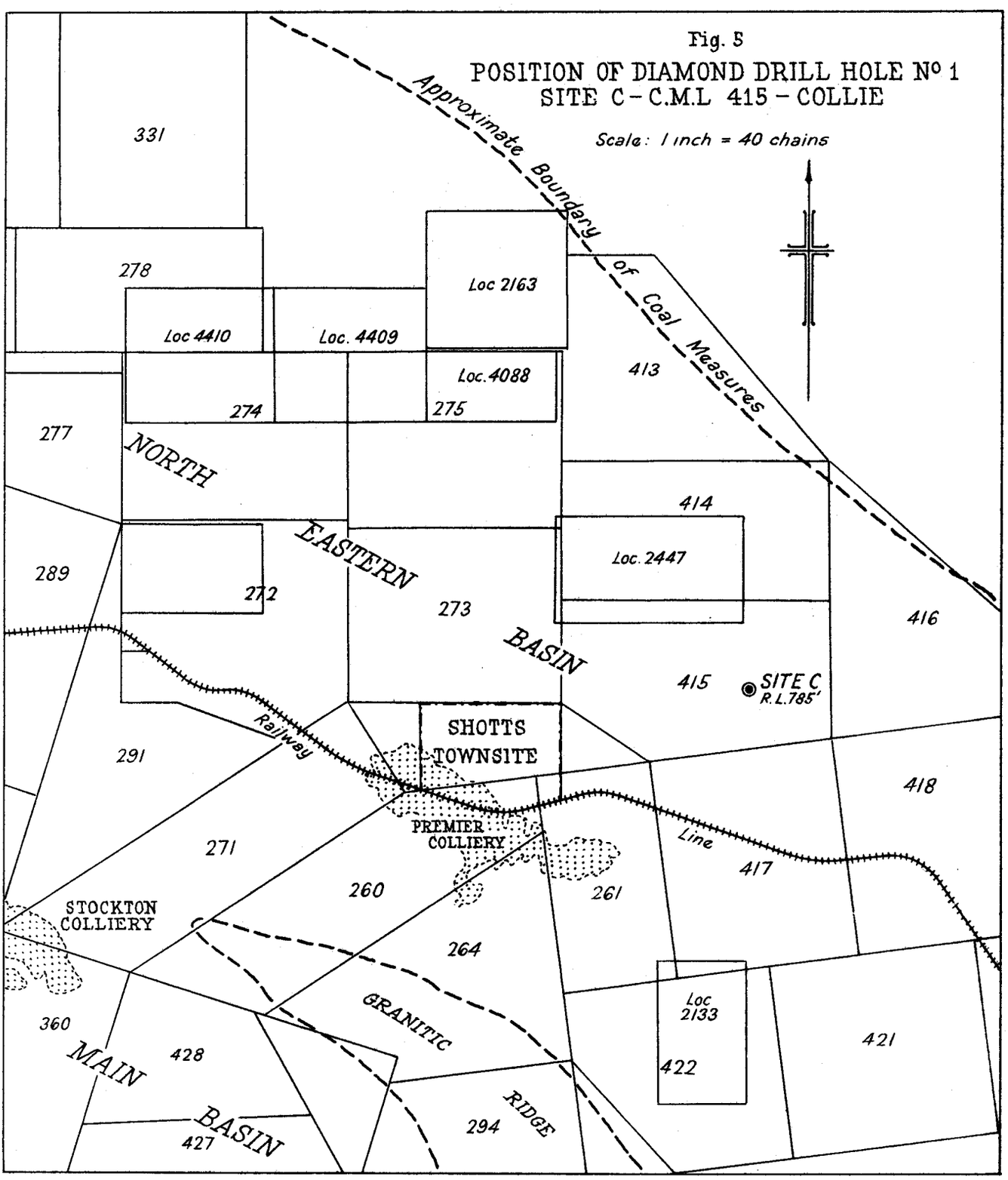


Fig. 5

POSITION OF DIAMOND DRILL HOLE Nº 1
SITE C - C.M.L 415 - COLLIE



GENERALISED DESCRIPTION	DEPTH IN FEET	COLLAR R.L. 785′	THICKNESS OF COAL	REMARKS
Lake Deposits	0			
Soft grey micaceous sandy shales with interbedded sandstones	50		11″	
			2′ 3″	PREMIER Nº 1
	100		4″	
			3″	
	150		4′ 7″	PREMIER Nº 2 Evidence of grinding, seam probably 5′6″ Shale roof and floor
	200		3″	
			4′ 0″	PREMIER Nº 3 Evidence of grinding, seam probably 5′6″ Shale roof and floor
			7′ 0″	PREMIER Nº 4 Shale roof and floor
	250		5″	
			9″	
	300		10″	
			6″	
			10″	
	350			
			3′ 4″	Sandstone roof and floor PREMIER Nº 5
Mainly sandstones	400		3′ 10″	PREMIER Nº 6 Sandstone roof and shale floor.
	450			
	500		8″	

GENERALISED DESCRIPTION	DEPTH IN FEET	COLLAR R.L. 785′	THICKNESS OF COAL	REMARKS
Medium to coarse-grained sandstones with interbedded sandy shale	500		1′ 5″ 10″	
	550			
	600			
	650		10″	
			7″	
Shales with interbedded sandstones	700		4′ 9″	Shale roof Sandstone floor
			1′ 1″	
	750		1′ 5″	
			1′ 2″	
			1′ 0″	
			4″	
	800		3′ 0″	Shale roof and floor with 4″ shale band between
			2′ 0″	
			1′ 5″	
Grey shales and sandstones	850			
			6″	
			1′ 10″	
	900		3′ 2″	Sandstone roof Shale floor
			4″	
			2′ 0″	
	950		1′ 2″	
			3″	
	1000			

GENERALISED DESCRIPTION	DEPTH IN FEET	COLLAR R.L. 785′	THICKNESS OF COAL	REMARKS
Mainly coarse-grained sandstones with some interbedded shales	1000			
			3″	
	1050		4″	
			7″	
	1100		6″	
	1150			
			10″	
	1200		3″	
			9″	
Shales and sandstones	1250		4′ 3″	Roof: Shale? with sandstone above, (with 2″ shale band) Floor: Sandstone 1″ with shale below.
	1300		1′ 8″	
			9″	
	1350			
Mainly sandstones	1400			
	1450			
			3′ 4″	Roof: Sandstone Floor: Shale 8″ with sandstone below.
			1′ 0″	
	1500		3″	

GENERALISED DESCRIPTION	DEPTH IN FEET	COLLAR R.L. 785′	THICKNESS OF COAL	REMARKS
Sandstone	1500		12′ 9″	EWINGTON Nº 1 Black carbonaceous shale roof. Floor: 4″ sandstone with shale below.
	1550		2′ 2″	EWINGTON Nº 2 Both seams show grinding probably 3&6″ Roof: Sandstone. Band of shale Floor: Black shale
			4′ 7″	
			11″	
	1600		8′ 9″	EWINGTON Nº 3 Roof: Sandstone Floor: Shale
			1′ 4″ 5″	
Mainly sandstone with occasional interbedded shales	1650			
	1700			
	1750			
	1800			
Shale	1850			
	1857			
Granite	1872			

Fig. 6

COLUMNAR SECTION

DIAMOND DRILL HOLE Nº 1
SITE C - C.M.L 415 - COLLIE

TABLE IV.

PROXIMATE ANALYSIS OF THE THICKER SEAMS INTERSECTED IN BORE AT SITE C.

Chem. Lab. No.	Depth.	Thickness of Sample.	As Received.					Dry and Ash Free.		Ash on Dry Basis.	Colour of Ash.
			Moisture.	Ash.	Vol. Matter.	Fixed Carbon.	Calorific Value.	Vol. Matter.	Calorific Value.		
	Feet.		%	%	%	%	B.Th.U.				
2368/50	179	4 9	20·0	3·3	29·9	46·8	9,650	39·0	12,580	4·1	Red-brown
2367/50	220	4 0	20·0	5·05	29·2	45·75	9,560	38·95	12,760	6·3	Brown
2369/50	238	7 0	20·0	5·6	28·4	46·0	9,265	38·15	12,460	7·0	Chocolate
2385/50	389	3 4	20·0	3·5	27·9	48·6	9,640	35·5	12,610	4·4	Red-brown
2386/50	397	3 10	20·0	2·9	29·65	47·45	9,765	38·4	12,660	3·6	Red-brown
2687/50	501½	1 10	20·0	6·95	26·60	46·45	9,210	36·4	12,610	8·7	Fawn
3296/50	692	4 9	20·0	7·4	26·8	45·8	9,245	36·95	12,740	9·23	Light fawn
3297/50	817	3 0	20·0	7·0	26·45	46·55	9,235	36·25	12,650	8·75	Fawn
3298/50	820¼	2 6	20·0	17·85	24·75	37·40	7,790	39·85	12,530	22·3	Buff
4087/50	896	2 0	20·0	8·20	24·85	46·95	9,170	34·65	12,760	10·25	Red-brown
4088/50	1,251¼	4 4	20·0	12·60	23·75	43·65	8,535	35·25	12,660	15·75	Red-brown
4089/50	1,303	1 8	20·0	7·65	27·20	45·15	9,165	37·60	12,660	9·55	Red-brown
4635/50	1,477	3 4	20·0	10·60	23·95	45·45	8,750	34·5	12,600	13·25	Red-brown
4637/50	1,499	2 6	20·0 *(18·28)	13·20	22·35	44·45	8,435	33·45	12,620	16·5	Dark brown
4638/50		4 0	20·0 (18·76)	9·65	22·85	47·50	8,990	32·5	12,780	12·05	Brown
4639/50		3 0	20·0 (19·36)	7·90	24·10	48·00	9,285	33·40	12,880	9·85	Brown
4640/50		3 3	20·0 (20·68)	6·30	25·55	48·15	9,045	34·65	12,270	7·9	Red-brown
Weighted Mean 1,499–1,511¾		12 9	....	9·08	....	....	8,980	....	....	....	
1,501½–1,511¾		10 6	....	8·07	....	....	9,090	....	....	....	
4920/50	1,565½	2 2	20·0	7·60	25·30	47·10	9,500	34·90	13,120	9·45	Brown
4921/50	1,569½	3 8	20·0	12·35	23·40	44·25	8,785	34·55	12,995	15·40	Light brown
4922/50		1 1	20·0	7·25	26·35	46·40	9,485	36·20	13,040	9·05	Light brown
4923/50	1,601⅓	2 8	20·0 (22·04)	6·05	22·65	51·30	9,660	30·60	13,065	7·55	Dark brown
4924/50		3 0	20·0 (22·04)	5·75	25·25	49·00	9,745	34·0	13,125	7·20	Dark brown
4925/50		3 0	20·0 (22·74)	6·25	26·45	47·30	9,790	35·85	13,275	7·80	Light brown
Weighted Mean 1,601⅓–1,610		8 8	....	6·02	....	....	9,730	....	13,170	....	
5352/50	1,634	1 5	20·00	8·95	27·0	44·05	9,675	38·0	13,620	11·2	Light brown

All moisture contents have been adjusted to 20 per cent.
* Moisture content shown in brackets indicates as received value.

Conclusion.

The first hole of the Collie deep drilling programme was completed when it encountered granite at 1,857 feet. Mud drilling overcame the hazardous casing difficulties previously experienced at Collie, while the core recovery was 57 per cent.

The coal horizons cut included only those which had been previously anticipated by the geologist, the quality being similar to that shown by the seams elsewhere on the coalfield with no improvement due to increase of depth.

AUSTRALIAN DRILLERS D.D. HOLE No. 1—SITE 'C' M.L. 415 N.E. of SHOTTS.

Depth (feet)	Summarised Log.
0 - 39	Lake deposits.
39 - 47	Sediments.
47 - 48	Coal (11").
48 - 64	Sediments.
64 - 66¼	Coal (2'3").
66¼ - 128	Sediments.
128 - 128⅓	Coal (4").
128⅓ - 141	Sediments.
141 - 141¼	Coal (3").
141¼ - 179	Sediments.
179 - 183½	Coal (4'7")—evidence of grinding, seam probably 5'6".
183½ - 215	Sediments.
215 - 215¼	Coal (3").
215¼ - 224	Sediments.
224 - 228	Coal (4'0")—evidence of grinding, seam probably 5'6".
228 - 238¼	Sediments.
238¼ - 245¼	Coal (7'0").
245¼ - 252	Sediments.
252 - 252½	Coal (5").
252½ - 286½	Sediments.
286½ - 287¼	Coal (9").
287¼ - 295	Sediments.
295 - 296	Coal (10").
296 - 310½	Sediments.
310½ - 311	Coal (6").
311 - 322	Sediments.
322 - 323	Coal (10").
323 - 389	Sediments.
389 - 392⅓	Coal (3'4").
392⅓ - 397	Sediments.
397 - 401	Coal (3'10").
401 - 497½	Sediments.
497½ - 498	Coal (8" dirty).
498 - 501	Sediments.
501 - 501½	Coal (5").
501½ - 503½	Coal (1'10").
503½ - 665	Sediments.
665 - 666	Coal (10").
666 - 675	Sediments.
675 - 675½	Coal (7").
675½ - 692¼	Sediments.
692¼ - 697	Coal (4'9").
697 - 738	Sediments.
738 - 739	Coal (13").
739 - 764½	Sediments.
764½ - 765	Coal (5").
765 - 767	Sediments.
767 - 768	Coal (14").
768 - 768½	Sediments.
768½ - 769½	Coal (12").
769½ - 783½	Sediments.

Depth (feet)	Summarised Log.
783½- 783¾	Coal (4").
783¾- 817	Sediments.
817 - 820	Coal (3'0").
820 - 820⅓	Sediments.
820⅓- 822⅓	Coal (2'0").
822⅓- 828½	Sediments.
828½- 830	Coal (1'5").
830 - 882	Sediments.
882 - 882½	Coal (6").
882½- 888½	Sediments.
888½- 890½	Coal (1'10") (broken Core).
890½- 896	Sediments.
896 - 899	COAL (3'2").
899 - 909	Sediments.
909 - 909⅓	COAL (4").
909⅓- 928	Sediments.
928 - 930	COAL (2'0" dirty).
930 - 952	Sediments.
952 - 953	COAL (1'2" dirty).
953 - 955	Sediments.
955 - 955¼	COAL (3").
955¼-1040	Sediments (several bands of black shale containing coal).
1040 -1040¼	COAL (3").
1040¼-1058	Sediments.
1058 -1058⅓	COAL (4").
1058⅓-1092	Sediments.
1092 -1092½	COAL (7").
1092½-1127	Sediments.
1127 -1127½	COAL (6").
1127½-1194	Sediments.
1194 -1195	COAL (10").
1195 -1209	Sediments.
1209 -1209¼	COAL (3").
1209¼-1218½	Sediments.
1218½-1219¼	COAL (9").
1219¼-1251¼	Sediments.
1251¼-1255½	COAL (4'3").
1255½-1301¼	Sediments.
1301¼-1303	COAL (1'8").
1303 -1333	Sediments.
1333 -1333¾	COAL (9").
1333¾-1377	Sediments.
1477 -1480⅓	COAL (3'4").
1480⅓-1491¼	Sediments.
1491¼-1492¼	COAL (1'0").
1492¼-1492¾	Sediments.
1492¾-1493	COAL (3").
1493 -1499	Sediments.
1499 -1511¾	COAL (12'9")
1511¾-1565½	Sediments.
1565½-1567¾	COAL (2'2").
1567¾-1569½	Sediments.
1569½-1574	COAL (4'7") (Note: Severe grinding —this seam may be 6'0").
1574 -1589	Sediments.
1589 -1590	COAL (11").
1590 -1601¼	Sediments.
1601¼-1610	COAL (8'9").
1610 -1632⅝	Sediments.
1632⅝-1632⅞	COAL (4").
1632⅞-1634	Sediments.
1634 -1635½	COAL (1'5").
1635½-1857	Sediments.
1857 -1872	Granite.

PROGRESS REPORT ON DIAMOND DRILLING, COLLIE MINERAL FIELD, W.A. (2).

Bore No. 2—Site L—Mineral lease 152, 2½ miles South of Collie Townsite.

By J. H. Lord, B.Sc., F.G.S., Geological Survey of Western Australia.

CONTENTS.

It is assumed that the reader is familiar with the information published in the first progress report, and only where there is any difference in procedure will comment be made in this report.

Drilling Procedure.

The drilling plant and rig was similar to that at Site C, except that a cement base was laid, onto which the plant and tower were erected.

The water for making the drilling mud was pumped from the river, some 1,200 yards distant. This water proved better chemically for the purpose than the bore water used in the previous hole.

The use of mud was again successful as only two lengths of NX casing were used. Bentonite was used at a rate of 3.0 pounds per foot as compared with 7.2 pounds per foot in No. 1 hole, the improvement probably being due to the better mixing properties of the water. No trouble was experienced from underground water or from the caving of the hole.

Seven diamond bits were used in the hole which means one bit per 191 feet of drilling as compared with one bit per 156 feet of drilling in No. 1 hole.

Three shifts were worked throughout the drilling of this hole.

A serious mishap occurred when drilling at a depth of 1,336 feet. A drilling rod broke at 676 feet below the collar of the hole, Apparently a "kink" which had developed in this rod caused it to revolve eccentrically thus causing excessive wear on one side, until eventually it wore through and the rod broke. This occurred on afternoon shift on 4th August. Fishing operations were commenced on day shift the following day.

First an outside tap was attached to the lost string of rods, but this tap broke when an attempt was made to pull. Later an inside tap was attached several times but the lost rods could not be moved, as apparently they were held fast by the cuttings and mud that had settled around them.

An attempt was made to drill over the lost rods with casing, without success.

The remaining possibility was to wedge the whole at 676 feet and drill on from there, but it was decided to abandon the hole because it was very doubtful whether a wedge would be successful.

Table 1 below sets out the manner in which the shifts (regardless of number of men employed) and man-shifts were distributed over the various operations, including the fourteen shifts lost while fishing for the lost rods.

TABLE I.

Time Distribution on Site L.

Operation.	Shifts.		Man-Shifts.	
	Number.	Percentage.	Number.	Percentage.
Drilling	63	52	126	35
Mud-mixing, breakdowns, fishing, etc.	36	30	120	34
Maintenance....	4½	4	14½	4
Setting-up and dismantling plant	17	14	97	27
Total	120½	....	357½	....

Fig. 7

DIAMOND DRILL HOLE Nº 2 — SITE L
PERCENTAGE CORE RECOVERY

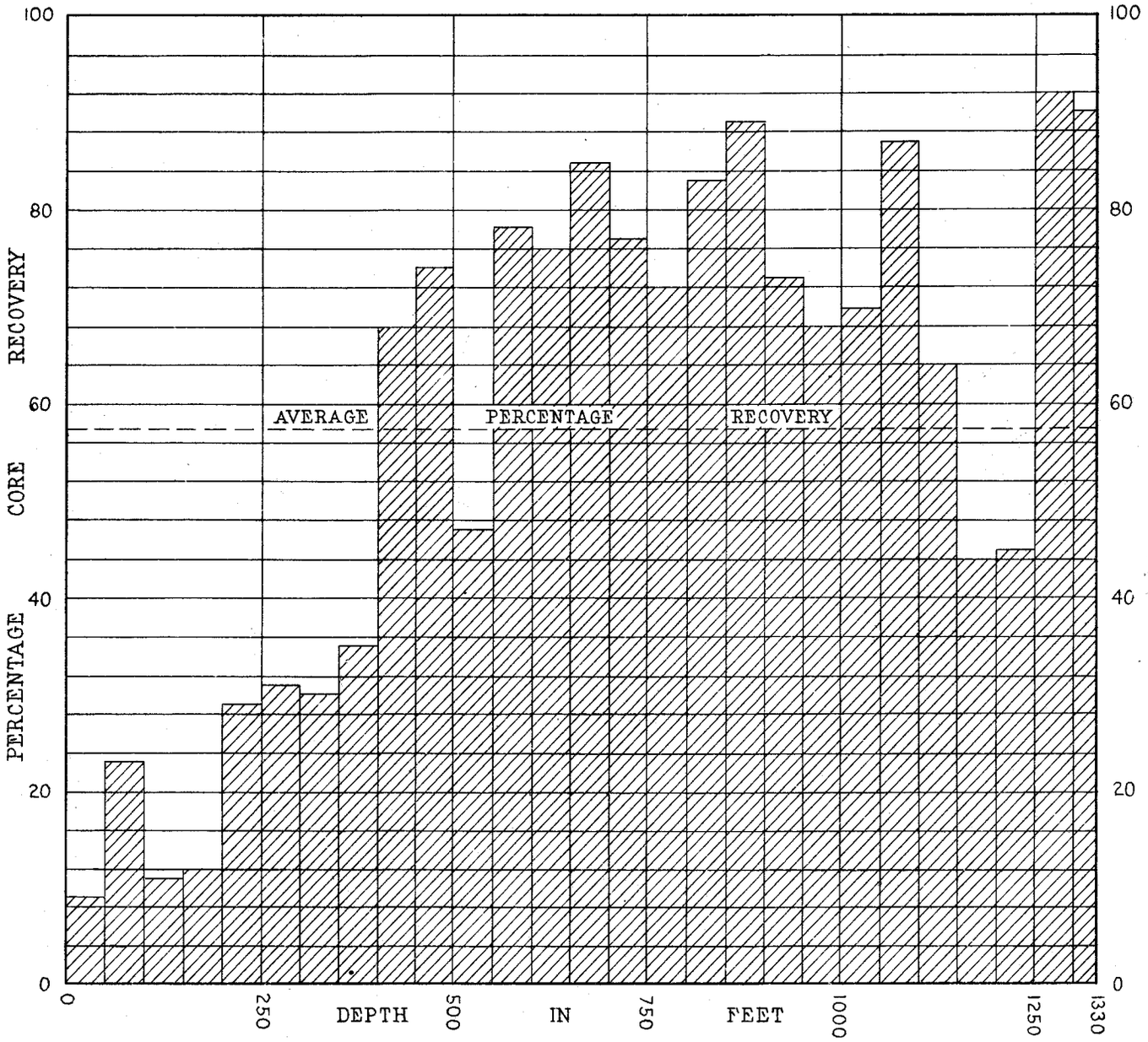
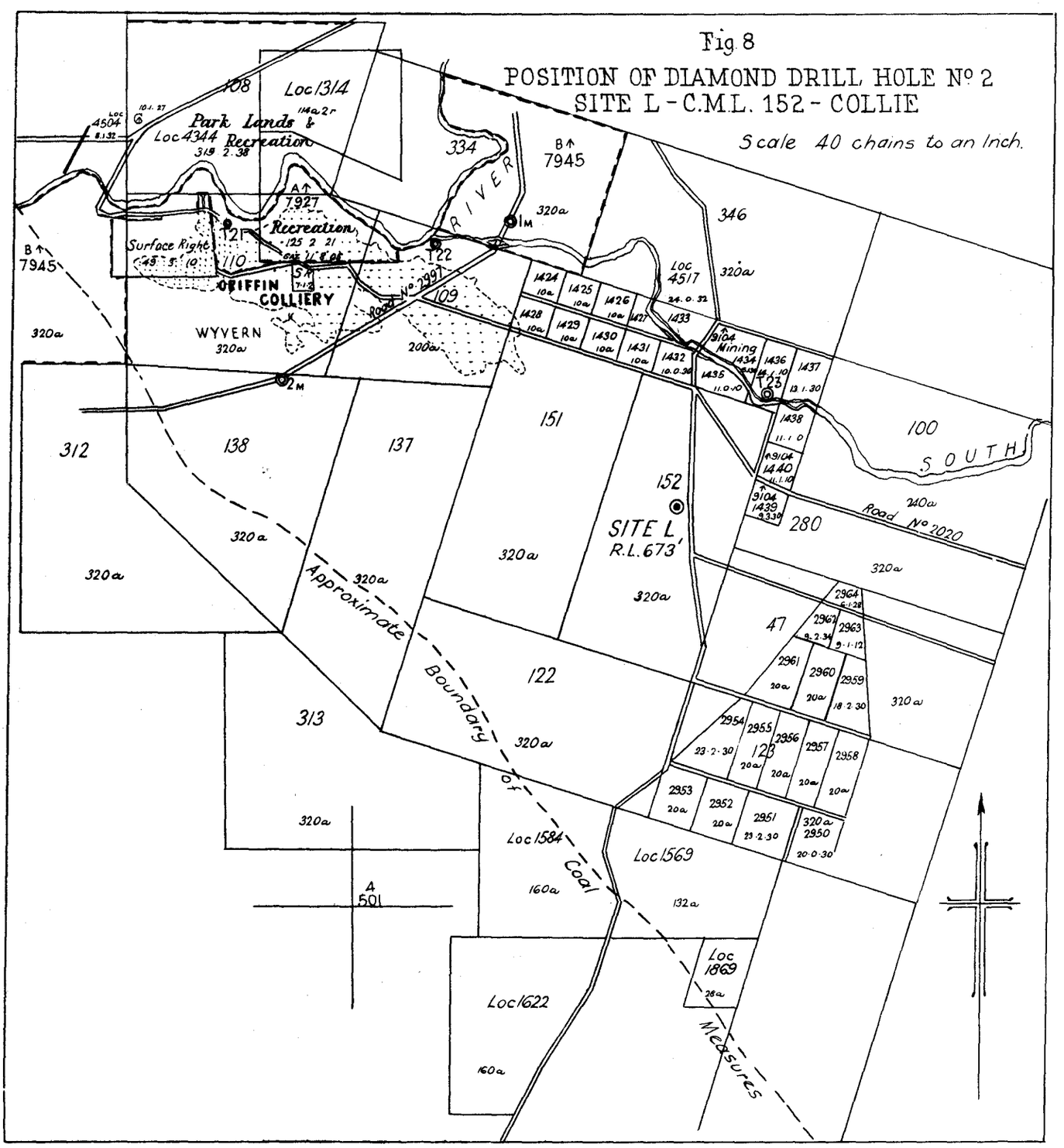


Fig. 8

POSITION OF DIAMOND DRILL HOLE Nº 2
SITE L - C.M.L. 152 - COLLIE

Scale 40 chains to an Inch.



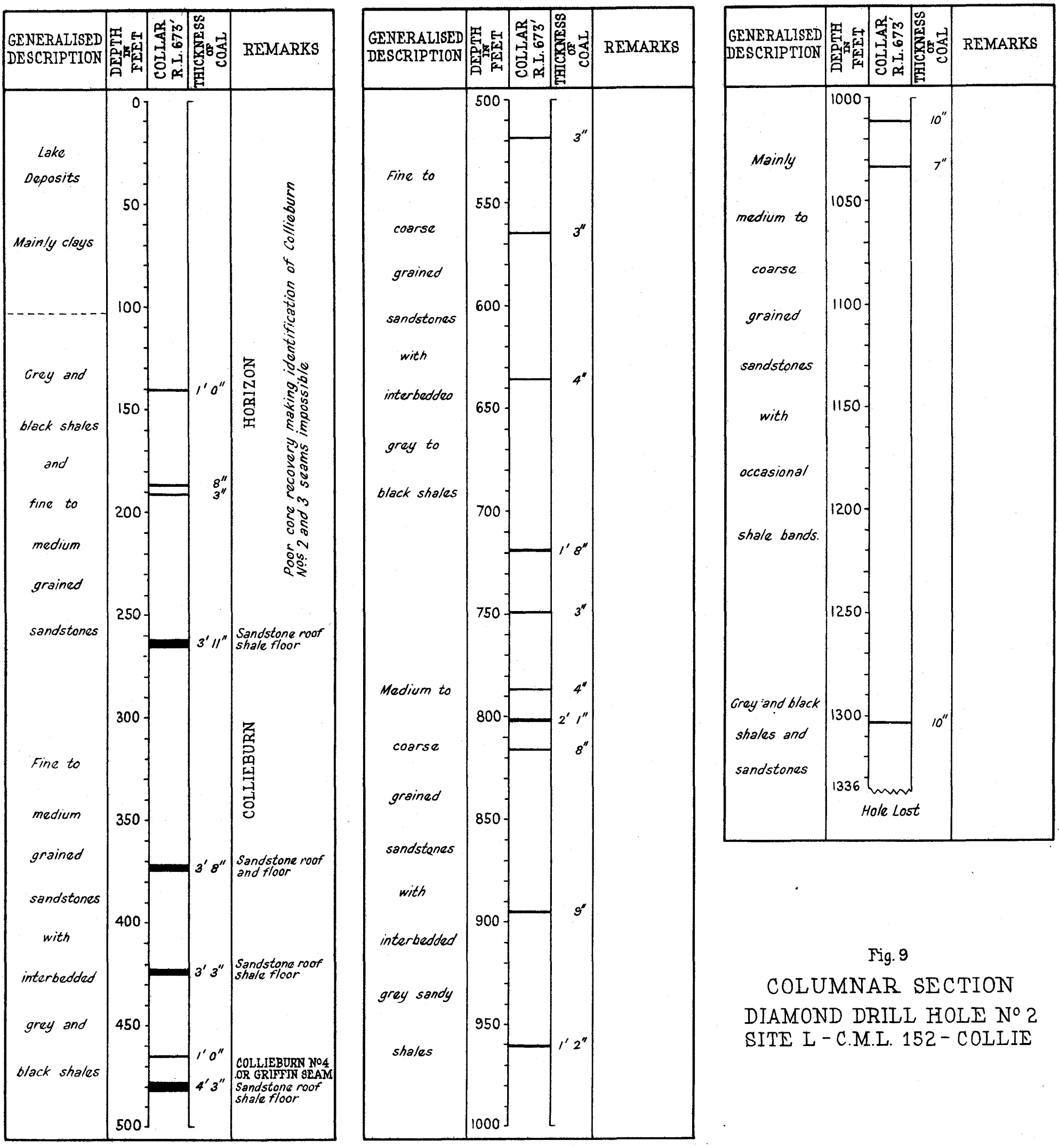


Fig. 9

COLUMNAR SECTION
DIAMOND DRILL HOLE N° 2
SITE L - C.M.L. 152 - COLLIE

Drilling of 3.9 feet was done per man shift as compared with 4.3 in No. 1 hole, but if the time lost spent fishing is excluded the rate was 4.7 feet per man-shift.

The following table ((Table II) is a study of the operations on shifts when drilling took place.

TABLE II.

Time Distribution while Drilling and Core Recovery.

Driller.	Number of Shifts Drilling.	Total Footage Drilled.	Core Recovered (Feet).	Average Footage Drilled per Shift.	Percentage Core Recovered.
Irvin	22½	414	246⅓	18·4	59·4
Koski	19½	459	253¼	23·5	55·1*
Thompson	21	452	264½	21·5	58·4
Miscellaneous	....	11	....	....	....
Total....	63	1,336	764	....	57·2*

* Allowance has been made for the 6 feet not pulled.

The average rate of drilling from the above table is 21.2 feet per shift as compared with 15.1 feet per shift on No. 1 hole. This illustrates the advantage of working three shifts although allowance must be made for the greater depth of No. 1 hole.

Core Recovery and Log.

As shown in Table II above, the overall total core recovery was 57%, just one per cent better than No. 1 hole. Figure 7 shows the percentage core recovered for each 50 feet drilled. It will be noticed that from the collar to a depth of 400 feet the core recovery was very poor being only 23%, whereas between 400 and 1,330 feet the average was 72%. Although the former was very disappointing as it included the Collie Burn horizon of coal seams, the latter improved core recovery was encouraging as much of the strata consisted of sandstones.

The lithology of the strata as shown in the core was similar to No. 1 hole and similar remarks apply to this log.

A summarised log (Appendix 1) is published with this report showing sediments and coal (three inches and above). A full detailed log has been prepared and is available at the Geological Survey.

Geology.

This hole on Lease 152 (Fig. 8) was drilled on a site recommended by the Geological Survey to test the Collie Burn horizon of coal seams between the Griffin Colliery and Collie Burn; and also to test the continuation of the Collie horizon of coal seams at depth in the main basin of the Collie Coalfield.

A columnar section (Fig. 9) shows all the coal seams (three inches and over) intersected. The first seams cut were those of the Collie Burn horizon which unfortunately, due to the poor core recovery, were difficult to identify. Below this horizon, that is below 500 feet, a great thickness of sandstone, shaley sandstone with occasional shale beds were encountered, but no coal of any importance. Due to the hole being lost at 1,336 feet, the depth where the Collie horizon was expected to be encountered was not reached.

It is considered that the 4ft. 3in. of coal recovered at 477 feet may be the No. 4 or Griffin seam of the Collie Burn horizon. The No. 3 and 2 seams could not be recognised due to poor core recovery and the No. 1 seam outcrops south of this site.

Quality of Coal.

The details of analyses carried out on samples submitted to the Government Chemical Laboratories are shown in Table III. The results of the proximate analyses of seams above 500 feet suggest that the seams are members of the Collie Burn horizon.

TABLE III.

Proximate Analysis of the Thicker Seams Intersected in Bore at Site L.

Chem. Lab. No.	Depth (feet).	Thickness of Sample.	As Received.					Dry and Ash Free.		Ash Dry Basis.	Colour of Ash.
			Moisture.	Ash.	Volume Matter.	Fixed Carbon.	Calorific Value.	Volume Matter.	Calorific Value.		
		ft. in.	%	%	%	%	B.Th.U.	%	B.Th.U.	%	
6703/50	140	1 0	20	5·15	32·15	42·70	10,010	43·0	13,385	6·45	Pink-brown.
6704/50	261	3 11	20	3·95	31·40	44·65	9,850	41·30	12,950	4·95	Light brown.
6705/50	371½	2 8	20	19·40	23·85	36·75	7,920	39·30	13,065	24·30	Pink.
6706/50	422	3 3	20	7·15	28·80	44·05	9,505	39·50	13,055	8·95	Pink.
6707/50	465	1 0	20	7·75	26·40	45·85	9,425	36·55	13,040	9·65	Pink.
6708/50	477¾	4 3	20	3·40	29·75	46·85	9,835	38·90	12,860	4·25	Red brown.
6830/50	718	1 8	20	2·60	27·25	50·15	9,605	35·25	12,420	3·30	Brown.
6974/50	801¼	2 1	20	5·15	28·0	46·85	10,060	37·45	13,440	6·45	Red brown.
6975/50	960½	1 2	20	6·25	28·95	44·80	9,865	39·35	13,370	7·85	Light brown.

Conclusion.

The second hole (site L) of the Collie deep drilling programme was abandoned at 1,336 feet because of a drill rod breaking at 676 feet.

Mud drilling which was again successful made casing unnecessary, while the core recovery was 57%.

The Collie Burn horizon of coal seams was encountered although the core recovery in the seams was poor. The hole was lost before reaching the lower Collie horizon.

AUSTRALIAN DRILLERS D.D. HOLE No. 2—SITE 'L' M.L. 152—2½ MILES SOUTH OF COLLIE.

Depth (feet)	Summarised Log.
0 - 103	Lake deposits.
103 - 140	Sediments.
140 - 141	COAL (12").
141 - 186	Sediments.
186 - 186⅔	COAL (8").
186⅔ - 191¾	Sediments.
191¾ - 192	COAL (3").
192 - 261½	Sediments.
261½ - 265½	COAL (3' 11" of core but badly broken and worn).
265½ - 371½	Sediments.
371½ - 374	COAL (3'8" of core but badly broken and worn).
374 - 422	Sediments.
422 - 425¼	COAL (3' 3" of core but badly broken).
425¼ - 465	Sediments.
465 - 466	COAL (12" broken core).
466 - 477¾	Sediments.
477¾ - 482	COAL (4' 3" broken core).
482 - 519	Sediments.

519 - 519¼ COAL (3" chips).
519¼- 564½ Sediments.
564½- 564¾ COAL (3" chips).
564¾- 636 Sediments.
636 - 636⅓ COAL (4").
636⅓- 718 Sediments.
718 - 719⅔ COAL (' 8").
719⅔- 749 Sediments.
749 - 749¼ COAL (3").
749¼- 787 Sediments.
787 - 787⅓ COAL (4").
787⅓- 801¼ Sediments.
801¼- 803⅓ COAL (2' 1").
803⅓- 816⅓ Sediments.
816⅓- 817 COAL (8").
817 - 894⅔ Sediments.
894⅔- 895 COAL (4").
895 - 895½ Sediments.
895½- 896¼ COAL (9").
896¼- 960½ Sediments.
960½- 961¾ COAL (1' 2").
961¾-1011¾ Sediments.
1011¾-1012½ COAL (10").
1012½-1033 Sediments.
1033 -1033½ COAL (7") (poor quality).
1033½-1303 Sediments.
1303 -1304 COAL (10").
1304 -1330 Sediments.
Hole lost.

PROGRESS REPORT ON DIAMOND DRILLING. COLLIE MINERAL FIELD, W.A. (3).

Bore No. 3.—Site E.—Mineral Lease 328, four miles East of Collie Townsite.

By J. H. Lord, B.Sc., F.G.S., Geological Survey of Western Australia.

CONTENTS.

It is assumed that the reader is familiar with the information published in the first progress report, and only where there is any difference in procedure will comment be made in this report.

Drilling Procedure.

The drilling plant and rig was similar to that at Site C, except that the tower was 45 feet instead of 85 feet in height. This alteration was made because the depth of the hole was anticipated to be from 700 to 800 feet only, so it was decided to break the rods every 30 feet instead of every 60 feet.

The water for mixing the bentonite was pumped from a small hole in a nearby swamp. As this water had a pH value of 5, a measured quantity of soda ash was added to obtain a better mud.

The use of mud was again successful as only the usual two 10-foot length of NX casting were used. In this hole a considerable amount of soft sandstone was encountered in the first 100 feet necessitating the use of a very thick mud. Bentonite was used at the rate of 3.2 pounds per foot as compared with 7.2 and 3.0 pounds per foot in No. 1 and No. 2 holes respectively. No trouble was experienced from underground water or caving.

Three diamond bits were used in the hole which means one bit per 201 feet of drilling as compared with one bit per 156 and 191 feet in No. 1 and No. 2 holes respectively.

Three shifts were worked throughout the drilling of this hole. No mishaps or breakages occurred and bedrock was reached successfully.

Table I below sets out the manner in which the shifts (regardless of number of men employed) and man-shifts were distributed over the various operations.

TABLE I.

Time Distribution on Site E.

Operation.	Shifts.		Man-Shifts.	
	Number.	Percentage.	Number.	Percentage.
Drilling	29	69	58	45
Mud-mixing, breakdowns, etc.	1	2	2	2
Maintenance....	2	5	4	3
Setting-up and dismantling plant	10	24	64	50
Total	42	....	128	....

4.7 feet of drilling was done per man-shift as compared with 4.3 and 3.9 (4.7 if "fishing" time excluded) feet per man-shift in hole No. 1 and No. 2 respectively. It should be noted that on this site 50 per cent. of the man-shifts were spent in setting-up and dismantling the plant, showing that this type of drilling plant is unsuitable for shallow holes.

Table II below is a study of the operations on shifts when drilling took place.

TABLE II.

Time Distribution while Drilling and Core Recovery.

Driller.	Number of Shifts Drilling.	Total Footage Drilled.	Core Recovery (Feet).	Average Footage per Shift.	Percentage ore Recovery.
Irvin	9	189	91	21·0	48·1
Koski	9½	198	82	20·8	41·5
Thompson	10½	207	116	19·7	56·1
Miscellaneous	....	10	....	....	....
Total	29	604	289	20·8	47·9

The average rate of drilling from the above table is 20.8 feet per shift as compared with 15.1 and 21.2 feet per shift in hole No. 1 and No. 2 respectively.

Core Recovery and Log.

As shown in Table II above, the overall total core recovery was 48 per cent. Fig. 10 shows the percentage core recovery for each 50 feet drilled. The core recovery of 48 per cent. for this hole does not compare favourably with the recovery of 56 per cent. and 57 per cent. for hole No. 1 and No. 2 respectively, but it must be remembered that this hole was only 604 feet deep and the core recovery in hole No. 1 and No. 2 was 57 per cent. and 37 per cent. respectively to an equivalent depth.

The general lithology of the strata as shown in the core was similar to the previous holes, except that there was a greater development of the basal conglomerate in this hole.

A summarised log (Appendix 1) is published with this report showing sediments and coal seams (three inches and above). A full detailed log has been prepared and is available at the Geological Survey.

Geology.

This hole, situated on Lease 328, (Fig. 11) was drilled on a site recommended by the Geophysical Survey to test this particular portion of the North-Eastern Basin between Stockton and what is known as Hard Coals (Leases 324 and 328).

A columnar section (Fig. 12) shows all the coal seams (three inches and thicker) intersected. The only seam intersected which is of economic importance is the 12ft. 10in. at a depth of 138 feet. This seam has three inches and one inch of shale at 19 and 9 inches above the bottom respectively, which detracts from its value.

Fig. 10

DIAMOND DRILL HOLE Nº 3 — SITE E
PERCENTAGE CORE RECOVERY

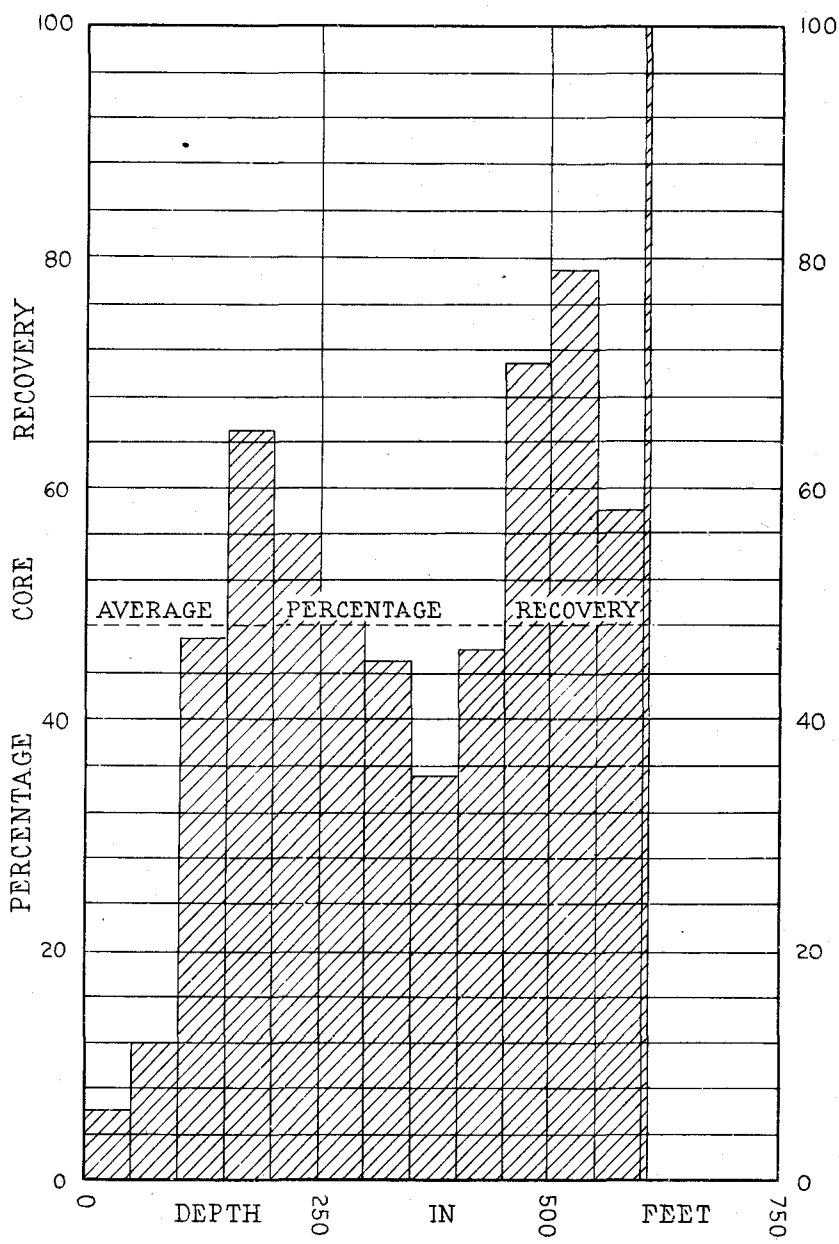
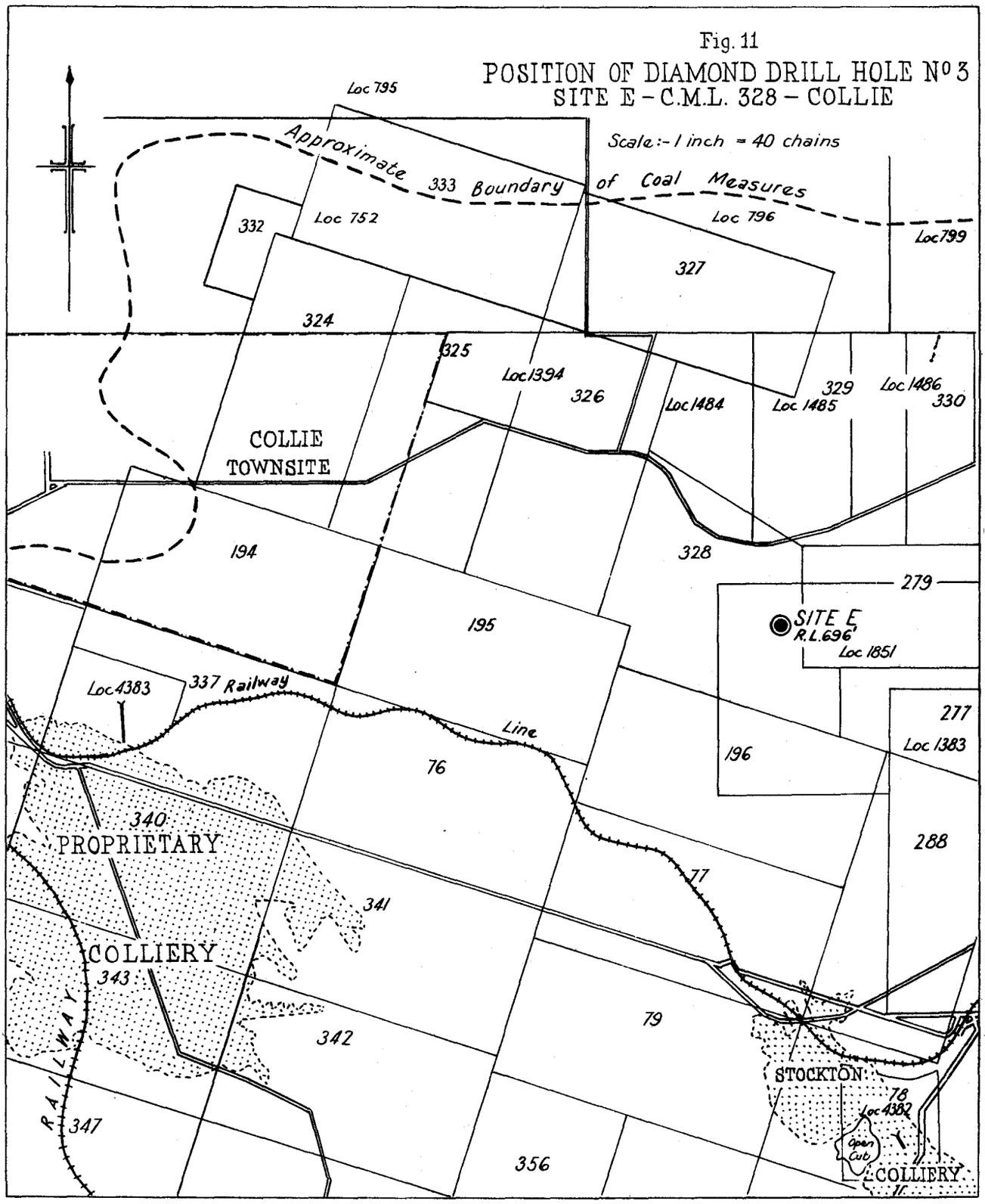
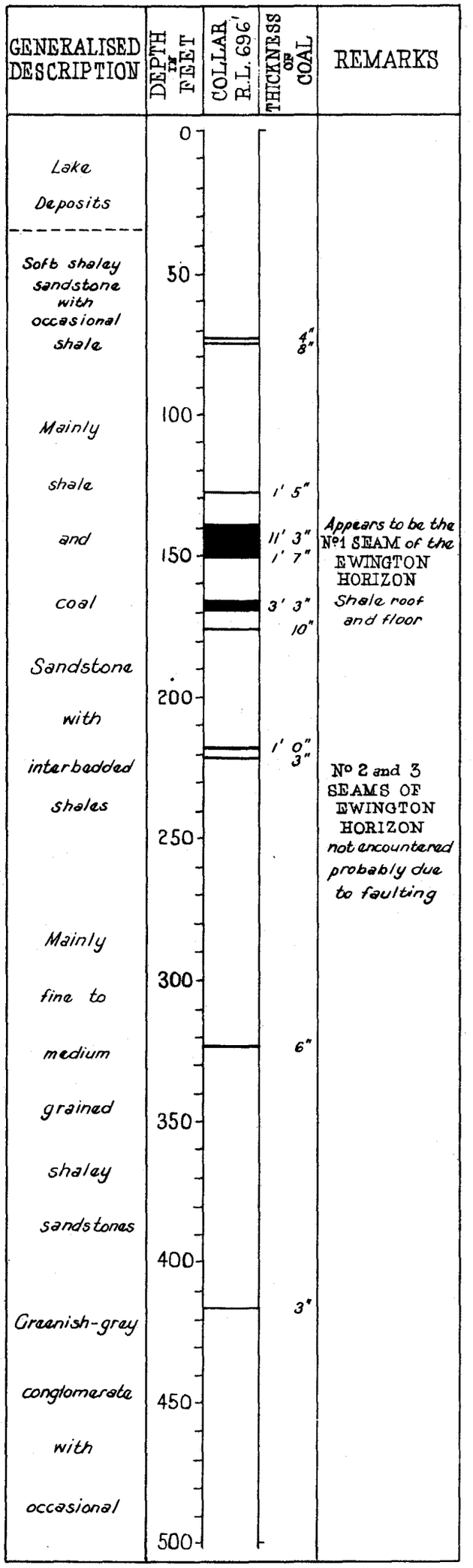


Fig. 11

POSITION OF DIAMOND DRILL HOLE Nº 3
SITE E – C.M.L. 328 – COLLIE





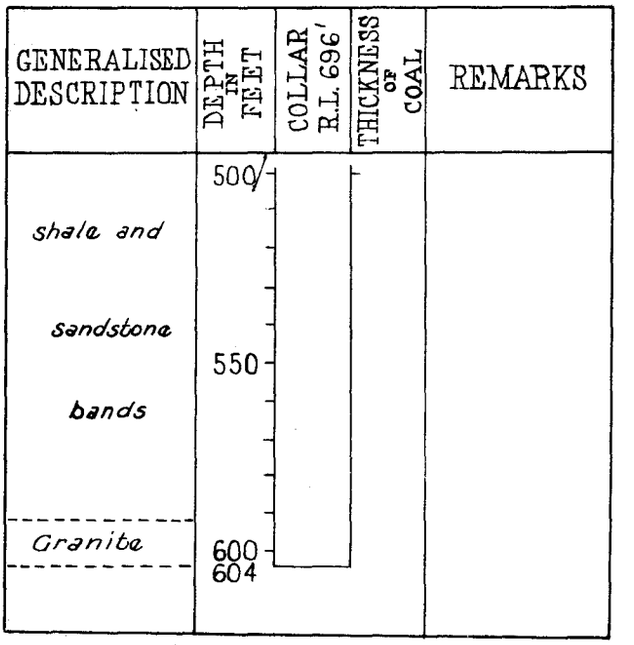
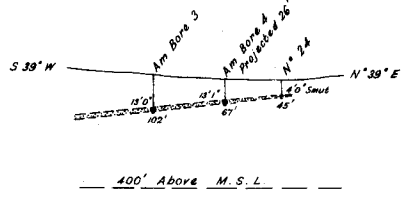


Fig. 12

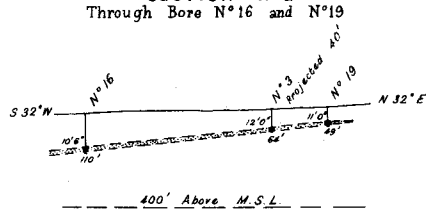
COLUMNAR SECTION
DIAMOND DRILL HOLE Nº3
SITE E - C.M.L. 328 - COLLIE

PLATE III

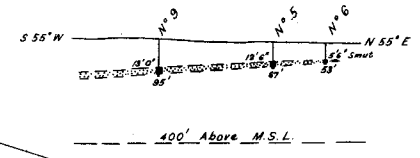
SECTION N°1
Through Am Bore 3 and Bore N°24

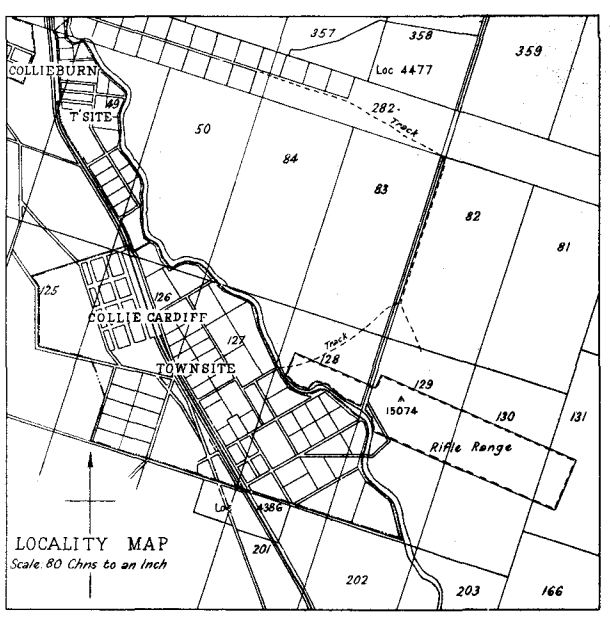


SECTION N° 2
Through Bore N°16 and N°19



SECTION N° 3
Through Bore N°9 and N°6





REFERENCE TO SIGNS

Borehole identification { Government Percussion Bore N° 25 / Amalg. Collieries Hand Bore Am Bore 3

Borehole - showing identification (N°9) reduced level (RL 673'), significant coal seam intersected (13'0" at 81'), and depth of borehole (95') } N°9 ● RL 673' 13'0" at 81' (95')

Lease boundary

Contours (at 10' interval)

Line of Section

Strike and dip of coal seam from borehole data and gradient of coal seam N60°W 5° (1 in 11½)

Approximate position of coal seam in section

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

CONTOUR PLAN AND SECTIONS
OF
PORTION OF MINING LEASES 82, 129 & 130
Showing Position of Boreholes and Details of Coal Intersected
EAST COLLIEBURN
COLLIE MINERAL FIELD

Scale: 8 Chains to an Inch

4 0 4 8 12

Planetable and Telescopic Alidade survey. Reference M.S.L.
Boreholes drilled and logged by Kent Bros. for G.S.W.A.
Supervised and compiled by J.H. Lord, B.Sc., F.G.S. Jan to Sept. 1950

W. R. M.

This seam is considered to be the No. 1 seam of the Ewington horizon, but the No. 2 and No. 3 seams of this horizon were not encountered as should be expected. The possible reason for this omission is either a fault, although no evidence has been seen in the core recovered, or, that the seams are lenticular in this portion of the basin. Although either may apply, it is recalled that diamond drilling on the Hard Coals leases some years ago produced results that could not be satisfactorily correlated; this therefore tends to favour the possible lenticular habit of the seams.

The basal conglomerate is worthy of note because of its association with greenish and occasionally reddish shales, indicating again the violent sudden changes in sedimentation. In places, the strata are contorted, indicating movement during consolidation of these sediments. The conglomerate carries pebbles and boulders of granite, quartzite and coarse-grained greenstone.

Quality of Coal.

The detailed analyses carried out on samples submitted to the Government Chemical Laboratories are shown in Table III.

TABLE III.

Proximate Analysis of the Thicker Seams Intersected in Bore at Site E.

Chem. Lab. No.	(feet).	Thickness of Sample.	As Received. Moisture.	Ash.	Volume Matter.	Fixed Carbon.	Calorific Value.	Dry and Ash Free. Volume Matter.	Calorific Value.	Ash Dry Basis.	Colour of Ash.
		ft. in.	%	%	%	%	B.Th.U.	%	B.Th.U.	%	
8547/50	138¼	2 9 }	20·0	12·15	20·25	47·60	8,815	29·85	12,990	15·2	Red-brown.
8548/50	141	3 0	20·0	9·8	20·95	49·25	9,230	29·85	13,150	12·25	Light red brown.
8549/50	144	3 10 } 12'10" seam	20·0	10·7	20·75	48·55	9,000	29·95	12,990	13·35	Dark red brown.
8550/50	147¾	1 6	20·0	17·4	19·3	43·3	8,145	30·80	13,020	21·75	Light red brown.
8551/50	149½	1 9 }	20·0	23·45	22·20	34·35	7,100	39·25	12,550	29·3	Light pink.
8552/50	156¼	3 5	20·0	6·55	23·15	50·30	9,640	31·55	13,120	8·2	Fawn.
8848/50	221	1 0	20·0	10·05	23·70	46·25	9,350	33·90	13,370	12·55	Brown.

The 12ft. 10in. seam was analysed in five sections as shown. The quality of the seam as a whole is not good, having a calorific value of only 8,650 B.Th.U's. with an ash content of 13.3% as received. The top 2ft. 9in. and the bottom 3ft. 3in. have a calorific value below 9,000 B.Th.U's., but the remaining 6ft. 10in. is the best portion of the seam, with a calorific value of 9,100 B.Th.U's. and 10.3% of ash as received.

Carbonisation assays (0° to 600°C.) were carried out on a composite of sample No. 8548-51 mixed in ratio of the thicknesses of the samples.

	Per 100 gm.	Per Ton.	Therms.
Solid Residue	63·7 gm.	12·7 cwt.	....
Liquor—100°C.	20·0 gm.	44·8 gals.	....
100°C.	4·92 gm.	11·0 gals.	....
Tar	2·68 gm.	6·0 gals.	....
Gas	7,880 ml.	2,825 c. ft.	11·7

Analysis.	Percentage Air-free.	Yield cu. ft.
CO_2	38·5	1,087
CnHm	1·6	44
H_2	23·5	664
CO	9·7	275
C_2H_6	3·1	88
CH_4	21·4	605
N_2	2·2	61

Calorific Value: 3,950 K.Cal/M_3, 413·6 B.Th.U/Cu. ft.

Conclusion.

The third hole (Site E) of the Collie deep drilling programme encountered the granitic bedrock of the North-Eastern Basin at 593 feet. Mud drilling was again successful with a core recovery of 48%.

Only one significant seam was encountered which is considered to be the No. 1 seam of the Ewington horizon; the remainder of the horizon was absent due either to faulting or to the lenticular nature of the seams. The quality of the seam was not good.

AUSTRALIAN DRILLERS D.D. HOLE No. 3.
Site E—M.L. 328—4 Miles East of Collie.

Depth (feet)	Summarised Log.
0 - 35	Lake deposits.
35 - 73⅓	Sediments.
73⅓- 73⅔	COAL (4").
73⅔- 74⅓	Sediments.
74⅓- 75	COAL (8").
75 - 127¼	Sediments.
127¼- 128⅝	COAL (1'5").
128⅝- 138¼	Sediments.
138¼- 149½	COAL (11'3").
149½- 149¾	Sediments.
149¾- 151¼	COAL (1'7").
151¼- 166½	Sediments.
166¼- 169¾	COAL (3'3").
169¾- 176¼	Sediments.
176¼- 177	COAL (10").
177 - 218	Sediments.
218 - 219	COAL (1'0").
219 - 221	Sediments.
221 - 221¼	COAL (3").
221¼- 323¼	Sediments.
323¼- 323¾	COAL (6").
323¾- 416	Sediments.
416 - 416¼	COAL (3").
416¼- 593	Sediments.
593 - 604	Granite.

SHALLOW DRILLING FOR OPEN-CUT COAL ON A PORTION OF MINERAL LEASES 82, 129 AND 130, EAST COLLIE BURN, COLLIE MINERAL FIELD, W.A.

By J. H. Lord, B.Sc., F.G.S., Geological Survey of W.A.

General Information.

The area, which has been investigated for open-cut coal, is a portion of Mineral Leases 82, 129 and 130 (original numbers) approximately 2½ miles E.S.E. of Collie Burn siding, as shown on Plate III.

Access is gained to the area by crossing the river either to the north of Collie Burn or near Collie Cardiff, and by following old timber tracks as indicated on the locality plan (Plate III).

The area has a good coverage of vegetation consisting chiefly of jarrah and red gum with some banksia, blackboy and paper bark in the hollows.

The first hole, a calyx hole, was drilled on this area by Mr. Bedlington on Lease 82 at the end of 1901. Late in 1946 Amalgamated Collieries of W.A. Ltd. commenced a series of shallow holes near Bedlington's calyx hole, and worked westwards. There is no record of any other drilling or mining operations having been carried out on this area.

The writer recommended to the Mines Department that exploratory drilling be carried out eastwards from the calyx hole. A grant of money was made available and the drilling programme described below was carried out by Kent Bros., percussion drilling contractors.

Geology and Drilling Results.

Bedlington's calyx hole was drilled to 545ft. At a depth of 36ft, 5ft. 9in. of soft coal was encountered, but the only other seam of note was 5ft. 4in. at 130½ft. The seam of soft coal was actually a portion of the "blind" outcrop of the No. 1 (or top) seam of the Collie Burn horizon. Had the calyx hole been two chains further south, the complete 12ft. seam would have been encountered.

The Amalgamated hand bores followed the No. 1 seam westwards where it varied from 12 to 13ft. in thickness, but the depth of the blind outcrop increased in that direction to nearly 80ft. This increase in the thickness of overburden covering the blind outcrop as the topography rises, was found to be also the case as drilling was extended eastwards. Actually, this increase represents a thickening of the Pliocene lake deposits, which overlie the Permian coal measures unconformably. Hence open-cut possibilities hinge on the topography, which unfortunately is not even, resulting in fair to good open-cut prospects in the gullies, but poor prospects on the ridges.

This No. 1 seam of the Collie Burn horizon was followed across Leases 129 and 130 for nearly one mile, with the object of locating shallow coal. All the drilling was planned to intersect the coal near the outcrop with an occasional hole further down the dip. Of the 32 holes drilled the seam was only missed on one occasion.

Hole No. 2 showed only 1ft 6in. of smutty coal, where the seam was estimated to be, but included 4½ft. of "pink and white light friable clay" which is thought to be the remains of the seam after burning. Other holes drilled in the vicinity of this hole showed the existence of the seam, although it was not quite as thick as usual. This area has been discarded in all calculations.

The general strike and dip of the seam can be best visualised from the structure contour plan (Plate IV—Fig. 2). The seam strikes N.38°W. at the west end of the area drilled, and swings to N.66°W., moving eastwards, but it swings back to N.39°W. at the eastern end of the area. The dip to the south-west varies from 7½ to 6 degrees from west to east.

The thickness of the seam (see Table I), where it is not the weathered blind outcrop, varies from 12 to 14 feet, except in the vicinity of bore No. 2 where the thickness decreases to 8ft. 6 in. in bore No. 20. The average thickness of the seam where encountered below the blind outcrop is 12ft. 6in.

The overburden (the Pliocene lake deposits) consists mainly of clays and sandy clays with a laterite capping on the ridges; the Permian coal measures consisting of sandstones and shales. There is no evidence of strata which would hinder the usual type of open-cut operations undertaken at Collie. The overburden is soft and would not require blasting.

TABLE I.

SUMMARY OF BORE LOGS ON M.L.'s 82, 129 AND 130 COLLIE MINERAL FIELD.

Govt. Percussion Bore No.	Reduced Level to M.S.L.	Depth of Seam Intersected.	Thickness of Seam.	Depth of Hole.	Depth to Water.	Remarks
	Feet.	Feet.	Ft. in.	Feet.	Feet.	
1	673	30	4 9	40	....	Smut. Blind outcrop.
2	682	77	1 6	120	71	Smut. Seam missing.
3	666	51	12 0	64	....	
4	665	64	13 0	77	39	
5	670	53½	12 6	67	47	
6	671	46½	5 6	53	No water	Smut.
7	690	84	14 0	99	73	
8	657	81	13 0	81	32	
9	673	81	13 0	95	45	
10	687	65	14 0	80	No water	
11	687	48	12 0	61	No water	Top 4' smut.
12	699	52	12 6	65	No water	
13	684	64	13 0	78	No water	
14	698	41½	6 6	49	No water	Smut.
15	718	67½	13 0	81	No water	Top 5½' smut
16	655	99	10 6	110	25	Some soft bands.
17	692	51	4 0	56	No water	
18	684	68½	12 6	82	59	
19	670	37	11 0	49	No water	
20	676	46½	8 6	56	No water	
21	682	41	13 0	55	No water	
22	690	72½	13 6	87	No water	
23	680	29	7 0	37	No water	Smut.
24	692	40	4 0	45	No water	Smut.
25	688	41	6 6	49	No water	Smut and poor coal.
26	672	59	9 0	69	No water	Broken coal.
27	706	83½	12 6	97	77	
28	694	....	....	64	No water	No coal.
29	760	91	5 0	97	No water	Smut.
30	737	78½	7 6	87	No water	Smut.
31	758	113½	13 6	128	No water	
32	727	108	14 0	123	101	

Quality of the Coal Seam.

As the seam in this area is the continuation of the No. 1 seam of the Collie Burn horizon, as previously drilled on T.R. 1235H at Collie Burn,[22] the quality should be similar.

Twenty-four analyses were carried out by the Government Chemical Laboratories on samples supplied from this drilling campaign, and the results are tabulated in Table II.

[22] Shallow Drilling on a Portion of Mineral Leases 49 and 50 (Temp. Reserve 1235H) at Collie Burn for Open-cut Coal, by J. H. Lord. G.S.W.A. Annual Report, 1949.

TABLE II.

ANALYSIS OF COAL FROM BORES ON M.L. 82, 129 AND 130, COLLIE, W.A.

Chem. Lab. No.	Bore No.	Depth.	Thickness of Sample.	As Received.					Dry and Ash Free.		Ash on Dry Basis.	Colour of Ash.
				Moisture.	Ash.	Vol. Matter.	Fixed Carbon.	Calorific Value.	Vol. Matter.	Calorific Value.		
		Feet.	ft. in.	%	%	%	%	B.Th.U.	%	B.Th.U.	%	
2365/50	3	51	4 0	20·0	3·8	27·25	48·95	9,495	35·80	12,460	4·75	White
2366/50	....	55	8 0	20·0	5·85	27·35	46·80	9,305	36·90	12,250	7·35	White
3294/50	7	84	5 6	20·0	4·85	29·15	46·00	9,585	38·85	12,750	6·05	Fawn
3295/50	....	89½	8 6	20·0	11·35	25·90	42·75	8,625	37·75	12,570	14·20	Fawn
3692/50	8	81	5 0	20·0	2·40	30·00	47·60	9,830	38·70	12,660	3·00	White
3693/50	....	86	8 0	20·0	5·60	27·80	46·60	9,335	37·37	12,540	7·00	Light fawn
3690/50	9	81	5 0	20·0	2·65	28·95	48·40	9,805	37·45	12,670	3·35	White
3691/50	....	86	8 0	20·0	3·50	28·50	48·00	9,630	37·25	12,590	4·40	White
4918/50	13	64	5 0	20·0	2·60	28·20	49·20	9,695	36·45	12,520	3·26	Light fawn
4919/50	....	69	8 0	20·0	3·20	29·25	47·55	9,480	38·10	12,345	4·00	Light fawn
4916/50	15	69½	5 6	20·0	2·90	29·50	47·60	9,320	38·25	12,100	3·60	Light fawn
4917/50	....	73	7 6	20·0	2·95	28·65	48·40	8,975	37·20	11,650	3·70	Light fawn
6709/50	16	99	10 6	20·0	3·60	29·20	47·20	9,580	38·25	12,540	4·50	Light fawn
6832/50	18	68½	12 6	20·0	2·75	29·40	47·85	9,680	38·05	12,525	3·45	White
6833/50	19	37	4 0	20·0	2·55	28·95	48·50	9,605	37·40	12,410	3·20	Light fawn
6834/50	....	41	7 0	20·0	4·55	28·65	46·80	9,470	38·00	12,560	5·70	Off white
6831/50	20	46½	4 6	20·0	3·05	29·35	47·70	9,715	38·00	12,640	3·85	White
6976/50	....	51	4 0	20·0	2·95	30·05	47·00	9,690	39·00	12,580	3·70	Light fawn
6977/50	21	41	4 0	20·0	6·36	28·50	45·15	8,610	38·65	11,695	7·95	Light fawn
6978/50	....	45	9 0	20·0	4·85	29·30	45·85	9,490	39·00	12,570	6·05	White
7526/50	26	59	4 6	20·0	3·75	26·40	49·85	10,100	34·65	13,250	4·70	Off white
7527/50	....	63½	4 6	20·0	3·25	31·40	45·35	9,245	40·95	12,050	4·05	Off white
8846/50	31	113½	4 0	20·0	3·65	27·20	49·15	9,775	35·65	12,800	4·55	Light fawn
8847/50	....	117½	9 6	20·0	4·10	28·55	47·35	9,655	37·65	12,720	5·10	Light fawn

PLATE IV

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

ISOPACH & STRUCTURE CONTOUR PLANS OF PORTION OF MINING LEASES 82, 129 & 130 EAST COLLIEBURN COLLIE MINERAL FIELD

Scale 8 Chains to an Inch

Compiled by J H Lord B.Sc., F.G.S. Oct 1950

ISOPACH PLAN

FIG I

Isopach lines ——— 50' ———

Borehole with identification and depth of overburden ● N°27 83½'

Explanation –
The contours on this plan join points having the same thickness of overburden overlying the coal seam

STRUCTURE CONTOUR PLAN

FIG II

Structure contours drawn on top of coal seam ——— 620' ———

Borehole with identification, thickness of seam and reduced level of top of seam ● N°32 14'0" 619'

W R M

The weighted mean analysis of the coal on a 20% moisture basis is 4.3% ash and a calorific value of 9,480 B.Th.U.'s/lb., which shows that the seam has improved in quality when compared with the results at Collie Burn of 8% ash and 9,300 B.Th.U's/lb. The dry ash-free value is lower than at Collie Burn.

The colour of the ash is white to light fawn, indicating an absence of iron and probably a high ash fusion point. The upper portion of the seam again analyses better than the lower portion.

The Laboratory also conducted Carbonisation Assays (0 to 600°C) on a composite sample of them (Lab. No. 4916-4919/50) for the following results on a 20% moisture basis at 110°C.:—

	Per 100 gm.	Per Ton.	Therms.
Solid Residue	61·7 gm.	12·3 cwt.	....
Liquor—100°C.	20·0 gm.	44·8 gals.	....
100°C.	8·1 gm.	18·1 gals.	....
Tar	5·1 gm.	11·4 gals.	....
Gas	10,510 ml.	3,770 c. ft.	17·1

Analysis.	Percentage.	cu. ft./ton.
CO_2	32·9	1,240
O_2	....	....
CnHm	1·7	65
H_2	12·6	475
CO	25·3	955
C_2H_4	3·4	130
CH_4	23·2	875
N_2	1·0	35

Calorific Value: 4,340 K.Cal./M_3, 454·0 B.Th.U./c. ft.

Coal Reserves.

This area is not an ideal open-cut site because of the irregular topography, which has the effect of making any open-cut long and narrow. The best ratio of overburden to coal is 3:1 in the gullies, and two small open-cuts could obtain a quantity of coal with an average ratio of 4½:1. However, since the cost of development, including roads etc., would probably not justify such action, the whole of the area is considered in the estimates below.

The northern limit of the open-cut has been fixed at the line which is considered to be the limit of the full thickness of the seam. Further north both the thickness and quality decreases rapidly, and the coal becomes smut. It may be possible to win a small tonnage from this area of lower overburden.

In all the estimates it is assumed that the seam averages 12 feet 6 inches in thickness and that 30 cubic feet of coal is equivalent to one ton. The estimates of overburden are approximate, and include an allowance for a 70 degree batter on the sides of the open-cut which is considerable, due to the narrow nature of the open-cut.

The areas considered are shown on the Isopach Plan (Plate IV.). This plan shows the contours joining points on the coal seam covered by equal thickness of overburden.

Ratio of 6 Overburden to 1 Coal.

Available Coal = 400,000 tons.
Overburden = 2,400,000 cubic yards.

Hence working to a depth of 74 feet of overburden to extract 12½ feet of coal, it will be necessary to remove approximately six cubic yards of overburden for every ton of coal.

Ratio of 8 Overburden to 1 Coal.

Available Coal = 900,000 tons.
Overburden = 6,600,000 cubic yards.

Hence working to a depth of 100 feet of overburden to extract 12½ feet of coal, it will be necessary to remove approximately 7.4 cubic yards of overburden for every ton of coal.

Costs.

The charge for this drilling was 12/6 per foot plus £5 for each hole less than 50 feet in depth. The total cost of the programme was £1,540 which is 0.41 pence per ton of coal located.

If geological and administrative expenses were added the cost would not exceed ½d. per ton.

Conclusion.

This open-cut site does not offer such good prospects as the existing open-cuts at Collie because of the larger amount of overburden to be removed. However, if it is not considered economical to extract the coal at present, the site provides a proven reserve for any national emergency.

Working to a maximum ratio of 6 of overburden to 1 of coal there is 400,000 tons of coal available, but if the ratio is increased to 8 to 1 there is 900,000 tons available.

The quality of the coal is better than at Collie Burn, having an average calorific value of 9,500 B.Th.U.'s/lb. with 4.3% ash on a 20% moisture basis.

REPORT ON THE SOUTH-WEST IRON RECONNAISSANCE.

By J. H. Lord, B.Sc., F.G.S.; N.M. Gray, B.Sc and J. Sofoulis, B.Sc.

Introduction.

H. A. Brasserts & Co., who are investigating the possibility of establishing the steel industry at Bunbury, Western Australia, requested that a reconnaissance survey be made of the area within a radius of 50 miles of Bunbury, to determine if there were any deposits of ferruginous laterite, similar to that at Wundowie, suitable for supplying ore to the industry.

To be classified as ore, the ferruginous laterite must adhere rigidly to the following specifications:—It must contain 45 per cent. more iron (Fe), less than 1 per cent. titanium oxide (TiO_2), and less than 10 per cent. silicia (SiO_2). The only permissable variation from these specifications is that laterite with 40 to 45 per cent. iron will be considered if it is in a large enough quantity but it must be within 30 miles of Bunbury.

The quantity required is two million tons, in deposits of a minimum of 50,000 tons if within 10 miles of a railroad; otherwise the deposits must contain 100,000 tons to be of any use. For a rough guidance ore five feet thick must cover two acres to represent 50,000 tons.

Fieldwork for this survey was recommenced on 16th January, 1950 and completed on the 26 May, 1950. The field party consisted of the following geologists:—J. H. Lord (in charge), N. M. Gray, J. Sofoulis, L. de la Hunty (March to end) and J. Gleeson (beginning to March). This report incorporates the views of all concerned, and has been expanded considerably, as it may be read by persons outside of W.A. who are unfamiliar with the physiography and geology of this portion of W.A.

Method of Work.

The extent of this area can be seen on the plan showing the locality of samples (Plate V.). This area of approximately 4,000 square miles was covered by two methods (a) walking traverses at approximately one mile intervals. This method was used on the eastern portion of the area. (b) Traverses along forestry tracks, timber-haulers' tracks and fire-breaks by utility with short walks from the tracks where required. This method was used in the western portion of the area to the Darling Scarp (see Plate V.). If the latter method did not provide a close enough grid the former method was used to fill in the blanks.

Publicity in the local Press was given to this search, and anyone with information of deposits was asked to leave such with the local Road Boards. Later all Road Boards were visited and

all reports investigated. The assistance of the Road Boards and Forestry officers is gratefully acknowledged.

As this was a reconnaissance survey no detailed mapping was done, but general geological information was noted on a set of 40-chain to an inch Lands Department Lithographs which are on a file at the Geological Survey's office.

Samples collected were analysed by the W.A. Government Chemical Laboratories. It should be explained that, although some samples show a high iron content, the extent of the deposit was usually very small, and the text description should be read in conjunction with each analysis.

Physiography.

A.—General Relief.

The area may be considered as consisting of the following physiographic units:—

(1) The eroded Pre-Cambrian block of the uplifted Darling peneplain. This comprises a major portion of the area investigated. Rivers, which vary from young to mature, have well dissected this plateau or peneplain. Hills are generally rounded, the crests of which lie between the 600 and 1,000-foot contour. A few higher peaks, rising to 1,500-foot contour, are considered to be remnants of the more resistant hills which rose above the general level of the original peneplain, Mt. Keats, Mt. William, Driver's Hill and Hill 60 are such examples.

Remnants of the sedimentary formations of lacustrine and estuarine origin, such as the Collie and Wilga coal measures, and scattered sand and boulder deposits are found on the plateau. Compared with the granitic surfaces, the topography of these deposits is of a milder form and at a lower contour.

Dense sclerophyllous forests with eucalypts forming the dominant tree species grow on the lateritised soil of this plateau, whilst the undergrowth practically covers the ground surface, so that erosion in this country is almost entirely confined to the action of rain and rivers.

(2) The Darling Scarp running north-south and bifurcating just south of the Collie River producing an additional scarp running south-west towards Cape Naturaliste (Whicher fault scarp). The main Darling Scarp is considerably indented and modified by the many drainage systems which flow to the coast.

(3) The country enclosed by the Dunsborough-Augusta, Whicher and Darling (southern extension) faults. This area is a slightly dissected plateau occurring at an intermediate level between the coastal plain and Pre-Cambrian plateau.

(4) The coastal plain, which is a flat featureless plain, largely made up of unconsolidated gravels, sands and clays with limestone and dune sand fringing the coastline.

B.—Drainage.

Rivers are numerous and vary from young or early mature to mature. The principal drainages are the Murray, Harvey, Harris, Bingham, Brunswick, Collie, Preston, Capel, Vasse, Margaret and Blackwood rivers. Where the rivers enter the coastal plain the meandering courses through their flood-plains have features of old rivers.

Although some of the larger drainage systems are perennial, most of the rivers in this area are intermittent and flow only during the wet months (May to October).

The rivers are characterised by rectangular courses the abrupt changes being due mostly to river capture (following the Darling uplift) but in part to deflection by the more resistant basic rocks and to the existence of major right-angled joints. Near the mouths, the action of the sea has been responsible for the deflection to the north or to the south.

A few lakes present in the eastern portion of the area are considered to be remnants of dismembered drainage systems, whilst those occurring near the coast have a barred basin origin, that is, portions of the ocean isolated by the building of sand bars.

Geology.

Rock Types.

PRE-CAMBRIAN.

Greenstones.

These are two ages of greenstones which, for convenience, will be called the "Younger" and the "Older Greenstones". This classification does not necessarily imply correlation with the various Greenstone Series of the Goldfields, although there is a certain similarity between the two. The "Older Greenstones" consist chiefly of amphibolites, some of which are metamorphosed basic lavas, various basic schists and meta-sediments. These "Older Greenstones" are scattered over the area and are usually of small extent, although some belts are up to ten miles in length.

The "Younger Greenstones", considered to be Proterozoic (Nullagine) age, are dolerites, which intrude both the "Older Greenstones" and the Granite/Gneiss Complex.

Granite/Gneiss Complex.

This Complex forms the bulk of the area. There are at least two stages of this Complex, one the "granite" which is truly a plutonic igneous intrusion and the other, the "gneiss", is generally considered to have been formed by granitisation.

The granite is considered to have been responsible for the mineralisation, e.g., tin, tantalite (and columbite), beryl, tourmaline and gold[23] [24], though the host rock of the gold has not been found.

PALAEOZOIC.

The only rocks of the Palaeozoic era are those of Permian and are confined to the Collie and Wilga coal measures.

MESOZOIC.

The Donnybrook sandstone is considered to be of Triassic age. This formation contains some insignificant coal seams and gold.

The extent of the belt has not been delineated, but, near Donnybrook, it appears to be wedged in between the Darling and Whicher Faults and overlaps in part the Granite/Gneiss Complex. It is possible that this formation may extend over the area bounded by these two faults as far west as the Dunsborough Fault.[25]

KAINOZOIC.

Boulder and Lake Beds.

These beds are lacustrine and estuarine deposits. Lord[26] considers that these beds may be of Pliocene age. Good exposures are found near Greenbushes, Collie and west of Kirup, but small deposits are found scattered throughout the area, not necessarily confined to the low ground. Tin is mined from these beds ("old Alluvium") at Greenbushes.

Laterite.

Lateritisation has been widespread throughout Western Australia, and this south-west portion of the State is no exception. Usually the best outcrops have been found on the ridges, but it is also found outcropping along the slopes and in the creeks. Its formation appears to be a function of the old topographies and of the underlying rocks.

The laterite occurring over the Granite/Gneiss Complex has a high alumina and a low iron content. This is as expected, but occasional boulders of high grade ferruginous laterite have been found, but the extent of the deposit was always small and was probably due to a concentration of ferro-magnesium minerals in that particular part of the Complex.

In the majority of cases it was not possible to determine the underlying rocks, but it is reasonable to assume that the larger deposits do not

---

[23] HOBSON, R. A. and MATHESON, R. S.: Greenbushes Mineral Field. G.S.W.A. Bull. No. 102, pp. 44, 71.

[24] CARROLL, D.: Mineralogy of the Donnybrook Sandstones, Western Australia. Journ. Roy. Soc. W.A., Vol. XXVII, pp. 211, 213.

[25] CARROLL, D.: Op. cit., p. 211, and Fig. 1.

[26] LORD, J. H.: Collie Mineral Field. G.S.W.A. Bull. No. 105

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

— MAP OF —

PORTION OF SOUTH WEST DIVISION — WESTERN AUSTRALIA —

WITHIN 50 MILES RADIUS OF BUNBURY

— SHOWING —

LOCALITIES INVESTIGATED DURING IRON AND LIMESTONE RECONNAISSANCES — OF THE AREA —

SCALE 1 INCH = 8 MILES

4 0 4 8 12

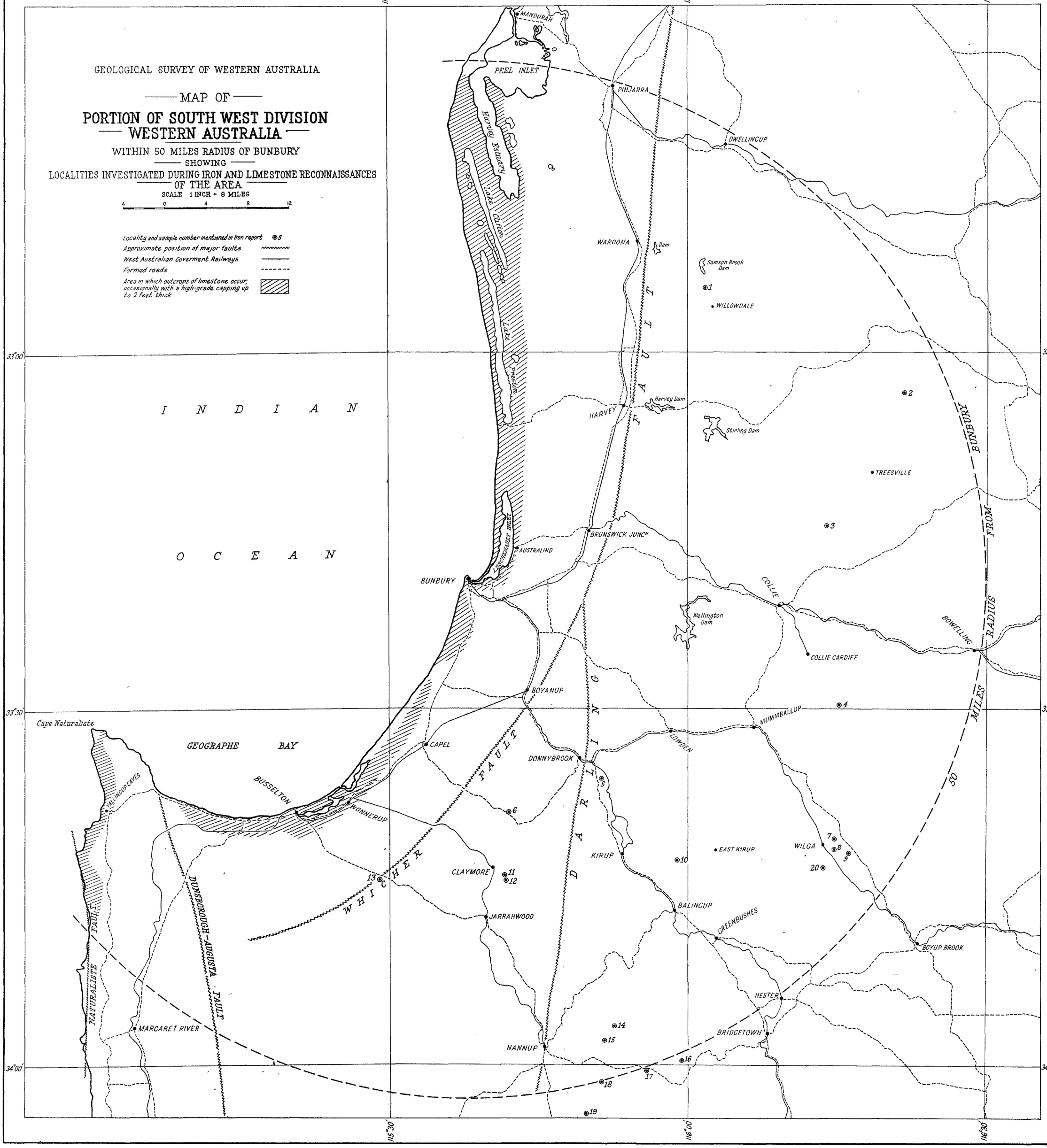
Locality and sample number mentioned in Iron report ◉5

Approximate position of major faults ~~~~~

West Australian Goverment Railways ———

Formed roads - - - - - -

Area in which outcrops of limestone occur, occasionally with a high-grade capping up to 2 feet thick ▨



overlie the Granite/Gneiss Complex. Near East Kirup a deposit showed bands of quartz separated by limonite suggesting that the deposit was overlying a jaspilite, which is probably the origin of larger deposits in the Pre-Cambrian section of the area. At Wilgee Springs a laterite with a low iron content overlies Lake Beds.

The laterite found in the creeks, particularly to the west of the Darling Scarp suggests a different or supplementary mode of origin. This type of laterite has a high iron and silica content in places in the creek beds, but the laterite found away from the creeks, as well as some in the creeks, is always very poor and sandy. It appears as if portions of the laterite in the creeks have undergone secondary enrichment.

The laterite is generally considered to be Miocene or thereabouts. At Collie there is definite evidence of lateritisation having taken place before and after the deposition of the Lake Beds.[27] In the Greenbushes area,[28] laterisation is considered to be post "Old Alluvium," i.e., late Tertiary.

Late Tertiary and Recent Deposits.

These deposits form the coastal plain consisting of limestones (usually sandy), sands, clays, unconsolidated gravels and basaltic flows near Bunbury.

Stratigraphy.

The summarised stratigraphical column may be given as follows:—

Era.	Period.	Rock Types, Groups or Formations.
Kainozoic	Quaternary	Coastal limestones, sands, clays and unconsolidated gravels. Balsatic flows at Bunbury.
	Tertiary	Laterite. Boulder Beds, Lake Beds, Old Alluvium. Laterite.
Mesozoic	Triassic	Donnybrook Sandstones.
Palaeozoic....	Permian	Collie and Wilga coal measures.
Pre-Cambrian	Proterozoic	Dolerite dykes (" Younger Greenstones ").
Pre-Cambrian	Archaeozoic	Granite/Gneiss complex and mineralisation. " Older Greenstones."

Structures.

The most significant structural features within this area are the faults. The Darling Fault, striking north and south, is the most prominent and extends from the south coast to some 200 miles north of this area. Within the area it passes approximately through Nannup, Donnybrook and a few miles east of Pinjarra. Near Donnybrook this fault bifurcates, one part continuing southwards and the other (the Whicher Fault) trends south-westwards (see Plate V.) dividing the Triassic from the coastal plain by the Whicher Range. The Whicher Fault is cut off by the Dunsborough-Augusta fault, which strikes north and south. To the west of this Dunsborough-Augusta Fault is granitic country in part overlain by coastal limestones which is thought to be cut off at or near the coast by the Naturaliste Fault.

The regional strike of the Pre-Cambrian is north-north-west, though strikes varying to N.60°E. were observed. Dips, where observed, were close to vertical.

[27] LORD, J. H.: Op. cit.

[28] HOBSON, R. A. and MATHESON, R. S.: Op. cit., p. 37.

Structural basins occur within the Pre-Cambrian and are occupied by Permian coal measures.

Economic Geology.

In the Pre-Cambrian, the only minerals of economic significance are tin and tantalite-columbite. These have been and are still being mined on a very small scale at Greenbushes.

Some dolerite dykes have been quarried for road metal.

The coal measures at Collie are the only one of importance. It is proposed to use coal from this field for the proposed steel industry.

At the beginning of the century, gold was mined from Donnybrook sandstone formation. This sandstone is an excellent building stone.

The iron possibilities of this area are discussed below.

Iron Deposits Located and/or Investigated.

Iron deposits found in this area are only superficial deposits which have formed by chemical action at or near the surface during lateritisation. The laterite containing the highest percentage of iron usually occurs three to six feet below the surface as a thin horizontal layer and does NOT extend to depths as a reef or lode. The nature of the underlying rocks influences the quality of the laterite as a possible iron ore.

In the course of the programme of work outlined above, many deposits were investigated from reports received, but the majority proved worthless. Some small areas of the type of laterite required were found, which however proved to be only a few boulders; therefore they are not recorded in this report. No doubt many deposits of this nature will be found from time to time, as it is impossible to cover every square yard of this large area.

Wilga.—To the east and south-east of Wilga siding, a belt of small deposits is located. The largest of the three deposits consists of boulders outcropping over an area of five acres at the south-east corner peg of Location 9251 (Lands Lithograph 415A/40). An average sample (No. 8—see Plate V.) from this area analysed Fe 49.54 per cent. and TiO_2 0.28 per cent. Whether there is sufficient ore here to make up the minimum tonnage of a workable deposit would require testing by pits, but it is doubtful.

The second deposit, a small deposit approximately 0.6 miles south-east of the south-east peg of Location 3944 (L.L.415A/40), covers less than half an acre, analysing Fe 47.67 per cent., TiO_2 0.11 per cent. (No. 9—PlateV.). The deposit consists of large boulders, but not in a continuous sheet. It is doubtful if prospecting could increase the size of this deposit to the minimum requirements.

The third deposit occurs near the south-east corner of Location 2945 (L.L.414B/40) and covers nearly two acres, but it is surrounded by poor quality laterite with a high silica content. This deposit consists of large and small boulders in a laterite soil, with boulders analysing Fe 51.14 per cent. and TiO_2 0.15 per cent. (No. 7—Plate V.). This deposit would not be of sufficient size to develop.

These three deposits are within a mile of good gravel roads and within two miles of the railway.

Detailed mapping along the belt formed by these three deposits may locate other such small deposits, but reconnaissance traverses did not disclose any large deposits although traces were found south of Wilga siding along the railway. It is considered that either the first or the three deposits together may produce the minimum tonnage for one single deposit.

Donnybrook-Claymore.—On the northern side of P.U.3801 (L.L. 414A/40) occurs a waterfall (winter only) on a southern tributary of the Capel River. The face of these falls is ferruginous laterite which analyses as follows:—

6a	Top to 3ft.	below	Fe	39.04%,	SiO_2	27.37%	TiO_2	0.62%
6b	3ft. to 6ft.	,,	Fe	35.78%,	SiO_2	32.03%	TiO_2	0.54%
6c	6ft. to 9ft.	,,	Fe	36.25%,	SiO_2	29.31%	TiO_2	0.70%
6d	9ft. to10½ft	,,	Fe	36.69%,	SiO_2	20.99%	TiO_2	0.30%
6e	10½ft. to 12ft.	,,	Fe	46.19%,	SiO_2	16.86%	TiO_2	0.35%

This laterite outcrops for a quarter of a mile southwards upstream. Further southwards it occurs spasmodically in this creek and its tributaries to Claymore. The quality is also variable.

At a point 120 chains east-north-east of the north-east corner of Location 1359 (L.L. 414D/40) is a rich patch in the creek, 20 feet wide over a length of 300 feet, which disappears under the sandy soil. This analysed Fe 57.70 per cent., TiO_2 Nil and Si 1.80 per cent. (No. 11—Plate V.). It is surrounded by poor quality laterite.

Near the old Claymore mill site (two miles south-east of Claymore siding) a similar occurrence in a creek bed analysed Fe 36.78 per cent., Si 8.92 per cent. (No. 12—Plate V.).

It is obvious that, although there may be a large tonnage available in this vicinity, the silica content is too high and the iron content too low to be exploited as an iron ore. It may be possible to use it to dilute very high-grade ore.

Nannup.—To the east and south-east of Nannup are numerous laterite-covered ridges. In this laterite occur small areas where there is a higher concentration of iron. However, the areas are too small and scattered to be worked economically, and unfortunately the specimen samples from a few of these selected areas showed a high titanium content, which makes it unusable as an ore for blast-furnace purposes.

No geologist of this survey issued any statement regarding the quality or quantity of these deposits, which are of no value.

The following samples were taken as specimen, not average, samples:—

No. 14. One mile east of North-east corner of Location 8301 (L.L. 439A/40).
Fe .... 34.9% TiO_2 .... 1.62%

No. 15. 3¼ miles east of north-east of C.G. 28 (L.L. 439A/40).
Fe .... 50.0% TiO_2 .... 0.21%

No. 16. North-west corner Location 3725 (L.L. 439B/40).
Fe .... 43.27% TiO_2 .... 1.45%

No. 17. 2½ miles east of east boundary of C.G. 7326 (L.L. 439B/40).
Fe .... 52.8% TiO_2 .... 2.16%

No. 18. 30 chains north-west of the north-east corner of Location 11077 (L.L.439A/40).
Fe .... 53.9% TiO_2 .... 2.01%

No. 19. North-east corner peg Location 11187 (L.L. 439D/40).
Fe .... 48.15% TiO_2 .... 1.69%

Numerous small deposits were examined but were unsuitable either through their poor quality or through insufficient quantity. Some of such deposits were:—

Willowdale—approximately 20 chains south-west of the north-west corner peg of C.G. 857 (L.L. 383B/40) exists a small patch of laterite analysing Fe 48.00 per cent. (No. 1—Plate V), but examination showed that it had no extent.

Treesville—to the north-east of Treesville and four miles south-west of Location 3642 (L.L. 384D/40) is a small patch of laterite analysing Fe 56.27 per cent. (No. 2—Plate V), but close examination of this isolated area showed only low grade laterite elsewhere.

Collie—10 miles north-east of Collie and approximately 20 chains south-east of the 2-mile peg on the northern boundary of Location 80/11 (L.L. 411B/40), is a small area of laterite bearing large pieces of iron ore, but analyses show that the titanium content is far too high.

	%		%
No. 3a Fe	56.25	TiO_2	9.45
No. 3b Fe	54.06	TiO_2	8.05
No. 3c Fe	51.30	TiO_2	11.75

Collie Cardiff—a large area of ferruginous laterite occurs in Location 1784 (L.L. 410D/40) on the north bank of the river, seven miles south of Collie Cardiff. The iron content 33.18 per cent. (No. 4—Plate V) is too low.

Brookhampton—at the junction of a creek and the road three-quarters of a mile north-west of the south-east peg of C.G. 288 (L.L. 414A/40) laterite occurs in the creek bed and extends upstream probably for half a mile, with an average width exposed of eight feet. The laterite is of no economic importance, because of its poor quality, namely, Fe 34.02 per cent., TiO_2 0.41 per cent. (No. 5—Plate V).

East Kirup—1½ miles south-west of south-west corner of Location 1922 (L.L. 414C/40). The quality is good, analysis showing Fe 52.16 per cent. (No. 10—Plate V), but the deposit, which occurs only as scattered boulders in a lateritic soil covering nearly an acre, is surrounded by poor laterite. Some boulders also show bands of quartz, suggesting that it is overlying a jaspilite.

Wilgee Springs—north-east corner C.G. 5294 (L.L. 414C/40), two miles south-west of Wilga. Large quantity exists covering over half of this location and some of the adjoining location, but the quality is too poor. An analysis showed Fe 27.12 per cent. (No. 12—Plate V).

Busselton-Jarrahwood—seven miles south-east of Busselton in a drain excavation at the south-west corner of Location 441 (L.L. 413C/40) there is a deposit with a maximum thickness of 2 feet showing covering approximately 1½ acres. Any possible extension is soil covered. An analysis showed Fe 49.50 per cent., TiO_2 Nil, and SiO_2 14.08 per cent. (No. 20—Plate V).

Greenbushes—a few small deposits occur in the vicinity of this town, the best and largest being at an old quarry 30 chains from the railway station. This quarry produced iron ore many years ago, and the best quality material has been removed. Although some ore which remains is of high enough grade, there is not sufficient available for the minimum requirements.

Hester's Siding—although slightly outside the 50-mile radius, there is a small deposit at the south-east corner of Location 7595 (L.L. 439B/40). The quality appears to be good, but the area is small.

Conclusion.

There is not two million tons of ferruginous laterite adhering to the specifications for iron ore set down by H. A. Brasserts & Co. within this area.

It is doubtful if further examination and testing by shafts of the deposits described would produce more than two deposits with the minimum tonnage of 50,000.

Under these specifications, no further work is justified.

SUMMARY REPORT ON SOUTH-WEST LIMESTONE RECONNAISSANCE.

By J. H. Lord, B.Sc., F.G.S.

The specifications of the limestone required by H. A. Brasserts & Co., for smelting iron ore were as follows:—

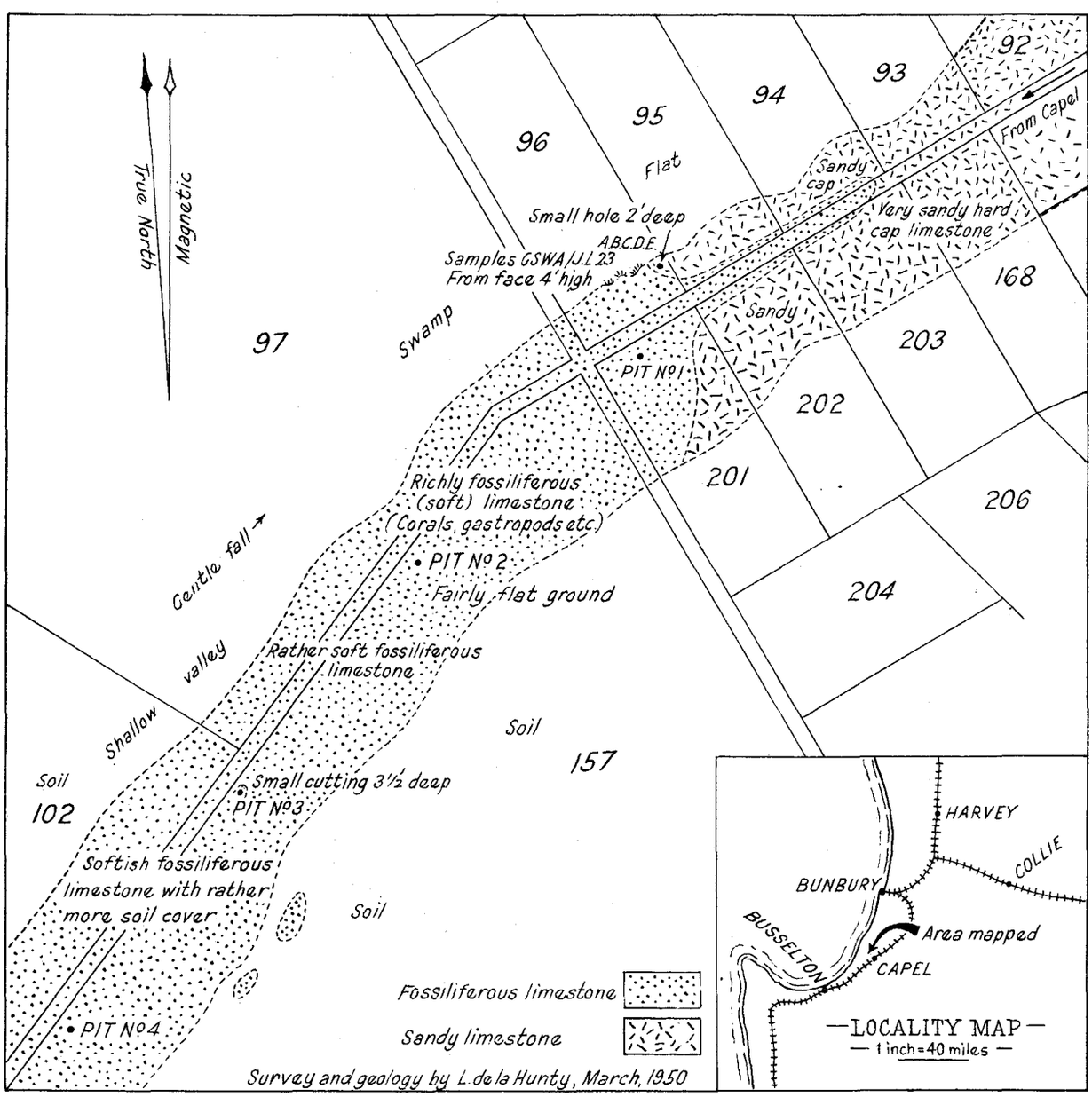
(a) It must contain *less* than 6 per cent. silica and *less* than 20 per cent. magnesia; (b) must have sufficient crushing strength to support a charge in a blast furnace, and (c) each locality must contain more than 10,000 tons of limestone, at least three feet thick, while the total requirement is 600,000 tons.

PLATE VI

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL MAP
— OF —
PORTION OF STIRLING ESTATE
3 MILES N.W. OF CAPEL
SOUTH WEST DIVISION
SHOWING LIMESTONE OUTCROP AREA

Scale: 1 inch = 10 chains



The investigation has been reported on in detail by Messrs. W. Johnson and L. de la Hunty, and the following conclusions are drawn from their reports.

The limestone within 50-miles radius of Bunbury occurs along the coastline extending inland for an average of two to three miles. There is an abundance of limestone within this area but the silica content is too high.

Four types of deposits were recognised by Johnson:—

(i) Aeolian limestones—on the coast between Cape Naturaliste and Cape Leeuwin, up to 400ft. in thickness—containing 14 to 30 per cent. silica with a capping rarely exceeding two feet in thickness of purer limestone.

(ii) Sandy fossiliferous marine limestone, containing 20 to 60 per cent. silica and an occasional capping as in (i).

(iii) Mechanical and chemical limestones, similar in composition to (ii).

(iv) Fossil reef limestones, considered originally to provide the best possibilities, but test pits showed it to be equivalent to type (ii) with a slight surface concentration of detrital coral.

The cappings found over some deposits of sandy limestone is the only limestone of sufficient hardness within the area, but these are too variable in quality and thickness to be exploited economically as a flux for smelting iron ore.

REPORT ON TESTING A LIMESTONE DEPOSIT THREE MILES NORTH-WEST OF CAPEL, SOUTH-WEST DIVISON.

By J. H. Lord, B.Sc., F.G.S.

This is the area recommended by W. Johnson in his report on a "Survey of the Limestone Deposits of the South-West Division within 50 miles radius of Bunbury," as the only area worthy of detailed examination. The area covers a portion of the Stirling Estate Locations 96, 97, 102, 157 and 201 as shown on Plate VI.

Four test pits were sunk along the centre line of the outcrop area of this deposit at positions shown on Plate VI, to an approximate depth of eight feet each. These pits were channel sampled and the material collected was analysed by the Western Australian Government Chemical Laboratories.

Geology.

The outcrop area of this deposit is shown on Plate VI. At the northern end approximately 25 per cent, of the surface is covered with limestone deposits, but this percentage decreases rapidly to the south. The soil cover appears to vary from one half to two feet in thickness.

The rubble found on the surface is mainly reef corals, which led Johnson to suggest that it was a fossil reef. However, on closer examination of the outcrops and the sinking of test pits, it was found that coral does not occur abundantly in the deposit. Apparently the odd pieces of detrital coral in the deposit have resisted weathering far better than the other marine shells and, in consequence, the surface rubble tends to give a false impression of the type of limestone below.

In the pits the deposit was found to be a sandy marine limestone. It is a soft, friable deposit, with occasional hard bars through it, which appear to be lines of secondary enrichment of calcium carbonate, but even these when broken are quite friable.

Sampling Results.

Each sample was obtained by quartering the material gathered, by cutting a channel down the wall of the pit. It is pointed out that to be of use as a flux the limestone must contain *less* than 6 per cent. silica.

The results of the analyses of dried samples are shown in Table I below.

TABLE I.

Field No.	Chem. Lab. No	Shaft No. Positions on Plate I.	Depth.	CaO.	$CaCO_3$.	SiO_2.
			Feet. From to	% Equiv. %		Equiv. %
GS/L 8	4361	1	½—4	46·61	83·16	9·44
GS/L 9	4362	1	4—6	46·40	82·80	11·60
GS/L 10	4363	1	6—8	42·93	76·64	17·86
GS/L 11	4364	2	½—4	48·01	86·01	7·93
GS/L 12	4365	2	4—6	47·09	84·54	9·20
GS/L 13	4366	2	6—8	45·33	81·42	11·49
GS/L 14	4367	Cutting	0—3½	49·91	88·08	4·39
GS/L 15	4368	3	½—2	53·14	94·84	2·11
GS/L 16	4369	3	2—4	53·37	95·24	1·81
GS/L 17	4370	3	4—6	52·07	92·92	1·03
GS/L 18	4371	4	½—3½	41·53	74·41	15·50
GS/L 19	4372	4	3½—5½	49·86	88·98	7·29
GS/L 20	4373	4	5½—7½	47·46	84·69	1·03

From these results the only pit that fulfils the quality specification is No. 3. Although the pits were sited at random, it appears from field evidence that pit No. 3 encountered a small patch of secondary enriched limestone.

Conclusion.

This deposit is not a fossil limestone reef and has been proven to be unsuitable as a flux for the iron industry because of its friability and high silica content.

REPORT ON SURVEY OF THE LIMESTONE DEPOSITS OF THE SOUTH WEST DIVISION OF W.A. WITHIN A RADIUS OF 50 MILES FROM BUNBURY.

By W. Johnson, B.Sc. (Hons.).

Introduction.

The purpose of the survey was to locate limestone deposits for use as a flux in blast furnaces, smelting iron ore. It was required by H. Brasserts Ltd., who propose to establish iron smelting works at Bunbury. The specifications required that the limestone contain less than 6% silica, less than 20% magnesia, and must have sufficient crushing strength to support a charge in the blast furnace.

To work any deposit economically it was required to be at least three feet thick and to contain more than 10,000 tons. The total initial requirements of limestone was 600,000 tons.

Method of Work.

Before commencing the survey the insoluble residue of various specimens of Coastal Limestone was determined (insoluble in warm HCl). Inspection of these samples showed that it would be possible to distiguish, by visual inspection, those limestones containing too much silica to be worth sampling.

The search took the form of walking rapid traverses through country in which the limestone outcropped and taking samples of that rock which it was impossible to discard by visual inspection.

This search took the form of a rapid reconaissance and it was intended to return and sample in detail, and to determine the reserves of, those deposits which showed promise.

Geology.

Preliminary work showed that limestone from the southern boundary of the area north to the Harvey River Diversion Channel is confined to a strip whose landward boundary is two miles to three miles from the coast. In this strip the actual outcrops of limestone are one quarter mile to one mile wide and are usually on the landward side of the narrow coastal lakes and swamps. The limestones were of four types—

(i) Aeolian limestones—mostly 14% to 30% silica.

SAMPLING RESULTS S.W. LIMESTONE SURVEY TO 3RD FEBRUARY, 1950.

Sample No.	Lithograph.	Locality of Sample.	Type of Limestone.	Type of Sample.	Residue after dissolving in warm HCl.
					Per cent.
JL 1	413D/40	At N.W. corner of Loc. 540	Cap of aeolian sandy granular limestone	Chip sample of small area of outcrop	4·5
JL 2	413D/40	At S.W. corner of Loc. 540	Cap of aeolian sandy granular limestone JL 1	Specimen only	1·0
JL 3	413D/40	15 chns. east of S.W. corner Loc. 810	Cap of aeolian sandy granular limestone JL 1 and 2	Chip sample of small area of outcrop	8·5
JL 4	413D/40	5 chns. N.E. of the N.E. corner Loc. 540	Cap of aeolian sandy granular limestone JL 1, etc.	Specimen only	1·0
JL 5	413D/40	8 chns. S. 20 chns. E. of S.W. corner Loc. 928	Cap of aeolian sandy granular limestone JL 1, etc.	Chip sample only	7·0
JL 6	413D/40	15 chns. W. 12 chns. S. of N.W. corner Loc. 928	Cap of aeolian sandy granular limestone JL 1, etc.	Specimen	0·5
JL 7	413D/40	30 chns. N. of S.W. corner of Loc. 346	Cap of aeolian sandy granular limestone JL 1, etc.	Specimen	3·0
JL 8	413D/40	70 chns. N. of S.W. corner of Loc. 346	Cap of aeolian sandy granular limestone JL 1, etc.	Specimen	4·5
JL 9	413D/40	40 chns. S. 10 chns. E. of S.W. corner Loc. 810	Cap of aeolian sandy granular limestone JL 1, etc.	Specimen	1·5
JL 10	413D/40	15 chns. S.W. of Moses Rock, Loc. 495	Cap of aeolian sandy granular limestone JL 1, etc.	Chip sample	0·5
JL 11	413B/40	40 chns. W. 20 chns. N. of S.E. corner of Loc. 4, Wonnerup	Cap limestone over sandy soft fossiliferous limestone	Specimen	1·0
JL 13	413A/40	On Loc. 1581 Locke Estate corner of N.–S. and E.–W. drains	Cap limestone over sandy soft fossiliferous limestone JL 11 but under cover of 3 ft. sand	Specimen	16·5
JL 14 A & B	413B/40	8 chns. W. of corner of roads and Locns. 102 CG, 60 and 157 Stirling Estate (corner P).	Sandy fossiliferous coral reef limestone plus capping	Channel samples down face of two old lime quarries, length of channel 2 ft. to 3½ ft. A and B from adjacent quarries	A 6·5 B 2·0
JL 15	413B/40	10 chns. S.W. of corner P (*see* above)	Capping of fossiliferous sandy limestone	Specimen	9·5
JL 16	413B/40	At corner P	A capping of B fossiliferous granular sandy limestone	Specimen	A 4·5 B 14·5
JL 17	413B/40	16 chns. along road N.E. from corner P	A capping of B fossiliferous granular sandy limestone JL 15	Specimen	14·5
JL 18	413B/40	32 chns. along road N.E. from corner P	A capping of B fossiliferous granular sandy limestone JL 15, etc.	Specimen	1·0
JL 19	413B/40	48 chns. along road N.E. from corner P	A capping of B fossiliferous granular sandy limestone JL 15, etc.	Specimen	1·0
JL 20	413B/40	S.E. corner Loc. 97 Stirling Estate 72 chns. N.E. along road from corner P	Calcareous algae and coral reef	Specimen	0·5
JL 21	413B/40	On road at common corner of Locns. 106 (N.E. corner) and 106 (S.E. corner) Stirling Estate	Cap of fossiliferous sandy limestone	Chip sample of fairly large area	5·5
JL 22	413B/40	At meeting corners Locns. 102, 103, 60, Stirling Estate	Cap of fossiliferous sandy limestone	Specimen	5·0
JL 23 A B C D E	413B/40	Loc. 95 Stirling Estate 2 chns. W. 3 chns. N. of S.W. corner A, B, C, D, E, at 20 feet intervals along quarry face and natural bank going S.E. from A located at 3 chns. W. 4 chns. N. of S.W. corner of Loc. 95	Fossil calcareous algae and coral reef with mollusco and brachipod shells	Channel samples average length 3 ft.	A 6·0 B 4·5 C 3·5 D 2·5 E 2·5
JL 25	411A/40	10 chns. due S. of S.E. corner Loc. 17 C.G.	Cap of and normal fossiliferous limestone	Channel sample 4 ft. long	14·5
JL 26	383D/40	65 chns. S., 5 chns. E. of N.E. corner Loc. 20 C.G.	Cap limestone	Specimen	9·5
JL 27	383D/40	Bank of Harvey River diversion channel where it meets E. boundary of Loc. 42 C.G. B and C 600 ft. apart	Fossiliferous granular sandy limestone	Channel samples 5 ft. long Specimen	B 45·5 C 27·5 16·0
JL 28	383D/40	20 chns. N. 28 chns. W. of S.E. corner Loc. 21 C.G.	Normal fossiliferous sandy limestone underlying cap		

(ii) Sandy fossiliferous marine limestones 20% to 60% silica.

(iii) Mechanical and chemical limestones.

(iv) Reef limestones.

Type (i) is confined to the western side of the Cape Naturaliste—Cape Leeuwin granite ridge. These sandy limestones are quite thick (up to 400 feet and more) and have a capping of very pure limestones of travertinous nature (see table of residues). Unfortunately this capping rarely exceeds two feet in thickness and is very variable in thickness, lateral extent and silica content.

Types (ii) and (iii) are associated and are all too sandy (siliceous) to be of any use, though they too have a travertinous capping of great purity in parts.

Type (iv) occurs most rarely and is the only one which offers promise of moderately large supplies of limestone of sufficient purity to be used in the blast furnace.

Sampling.

Most of the samples are chip or grab samples taken horizontally from outcrops of travertinous capping. As such they indicate no more than that the capping in the vicinity of the specimen or sample is pure or impure. More useful samples were taken from natural or artificial vertical sections. These invariably illustrated that in deposits of types (i) (ii) and (iii) the capping was much purer than the body of the deposit. Samples JL 16 A and B are an excellent example; JL 16 A representing the top nine inches of travertinous capping has a residue of 4.5 per cent. JL 16 B representing the underlying normal rock has 14.5 per cent. residue.

Recommendation.

From the results of the reconnaissance examination of the area as far north as the Harvey Diversion Channel it is recommended that only one area is worthy of immediate detailed examination. This is the area extending approximately from the south-west corner Loc. 122 to the south-west corner Loc. 104 Stirling Estate. The area averages 20 chains in width and may extend under cover farther south-east. The area is depicted by cross hatching on a litho 413 B/40, in the Geological Survey Office. Within this area the most favourable portion to investigate is the portion enclosed in the red line comprising parts of Locs. 97, 157, 96, 95, 94, 201, 202 and 203, Stirling Estate.

If this area fails to prove of use on detailed examination by means of sample pits or bore holes, then it is doubtful whether usable limestone will be located in other parts of the coastal area within 50 miles of Bunbury. But as a last resort any of the areas of cap limestone shown on the lithographs might be investigated. However, the writer is of the opinion that none of the deposits of high grade cap limestone are of sufficient vertical or lateral extent to be economically mined. The remarks in this report apply only to that area investigated by the writer and the geologists under his charge.

REPORT ON SURVEY OF LIMESTONE DEPOSITS BETWEEN HARVEY RIVER DIVERSION CHANNEL AND MANDURAH, SOUTH-WEST DIVISION.

By L. E. de la Hunty, B.Sc.

Introduction.

This report is in furtherance to that of Mr. W. Johnson.[29] It is therefore patterned on his report and his classifications will be adhered to.

Method of Work.

Work was carried out under the instruction and supervision of Mr. W. Johnson.

It took the form of rapid reconnaissance in search of limestone likely to fulfil the qualifications already outlined by him. General gridding of the area was carried out, together with inspections of any likely areas suggested by local inhabitants.

Samples were taken wherever the rocks were not obviously too sandy.

Geology.

Only the coastal strip is dealt with since lime stone only outcrops up to five miles east of the coast.

The country to the west of Lakes Preston and Clifton consists of sand dunes with outcrops of very sandy aeolian limestone. The limestone around the Harvey Estuary and Peel Inlet also falls into the same category. Only that limestone to the east of the coastal lakes is worthy of consideration.

The types of limestone outlined by Mr. Johnson[30] are—

(i) Aeolian limestones.

(ii) Fossiliferous marine limestones.

(iii) Mechanical and chemical limestones.

(iv) Reef limestones.

Most of the limestone in this area is of type (i) and occupies all the ridges. It has the usual travertine cap which is low in silica content.

In the low-lying parts type (ii) is apparent but seems to have a lower silica content than the outcrops to the south.

[29] "Report on Survey of the Limestone Deposits of the South-West Division of W.A. Within a Radius of 50 Miles from Bunbury." G.S.W.A. Ann. Rept., 1950.

[30] Op. cit.

Type (iii) is sandy and of little use, while type (iv) is rare.

The floors of Lakes Preston and Clifton consist, in places, of loosely packed shell beds—mainly small pelecypods with occasional ostrea. As a source of lime, these beds should be ideal but they are quite unsuitable for the present purpose.

Sampling.

The method of sampling used was that of taking random chips (approximately one cubic inch) from the surface—over areas up to one acre. Where boulders outcropped two to three feet above ground level, chips were taken from ground level as well as from the tops of the boulders.

Results.

No deposits of limestone conforming to the specifications laid down were located.

Sample No.	Lithograph No.	Locality of Sample.	Type of Limestone.	Residue after dissolving in warm HCl.
				%
LD 1	413A/40	30 chains W of NE corner Loc. 1044	Cap of aeolian sandy limestone	1·5
LD 2	413A/40	10 chains N of Sugarloaf Spring, Loc. 332	Cap of aeolian sandy limestone	2·0
LD 3	413B/40	14 chains N30°W of SE corner Loc. 318	Fossiliferous marine	4·0
LD 4	413B/40	35 chains SW of NE corner Loc. 9	Fossiliferous marine	13·5
LD 5	413B/40	25 chains N of SE corner Loc. 6	Fossiliferous marine	8·6
LD 6	413B/40	37 chains NW of SE corner Loc. 6	Fossiliferous marine	3·5
LD 7	413B/40	Junction of Busselton-Augusta Railway with S boundary Loc. 6	Fossiliferous marine	6·0
LD 8	383D/40	SE corner Loc. 1794	Cap of aeolian sandy limestone	14·5
LD 9	383D/40	15 chains W of NE corner Loc. 1251	Cap of aeolian sandy limestone	1·0
LD 10	383D/40	37 chains S60°W of NE corner Loc. 48	Cap of aeolian sandy limestone	2·5
LD 11	383D/40	10 chains W of SE corner Loc. 2622	Fossiliferous marine	1·0
LD 12	383A/40	2 chains W of NW corner of Reserve 11708	Cap of aeolian sandy limestone	12·0
LD 13	383A/40	E shore of Lake Clifton	Soft chemical limestone	2·0
LD 14	383D/40	SE corner of Loc. 1794	Cap of aeolian sandy limestone	6·0

Index to Geological Survey Annual Progress Report for 1950.

Division V.

School of Mines, Western Australia.

The Under Secretary for Mines.

I submit herewith, for the information of the Hon. Minister for Mines, my Annual Report for 1950.

1.—School of Mines, Kalgoorlie.

Enrolments.

The total number of students enrolled during 1950 was 390—an increase of 30 over the number enrolled during the previous year. Individual enrolments and class enrolments for 1948, 1949 and 1950 are given in table 1. Unfortunately the increase in the number of students enrolled was, to some extent, off-set by an increase in the number of students who discontinued their studies during the year. This will be referred to again in a later section of the report (see table 3).

TABLE 1.

Enrolments 1948, 1949 *and* 1950.

Year.	1st Term.		2nd Term.		3rd Term.	
	Individual.	Class.	Individual.	Class.	Individual.	Class.
1948	397	1,491	358	1,365	310	1,253
1949	344	1,077	307	958	258	841
1950	361	907	320	771	309	671

The number of students enrolled in the various subjects is given in table 2.

The total enrolment of 390 students was made up as follows:

(1) Students who are not returned servicemen and who are:

(i) Paying class fees

Full-time	3	
Part-time	69	
		— 72

(ii) Paying only a registration fee (5/- per year) or who are exempt from fees.

Full-time	13	
Part-time	148	
		— 161

(2) Students who are returned servicemen and who are exempt from fees (General Regulation 5). Not enrolled under C.R.T.S.

Full-time	....	
Part-time	94	
		— 94

(3) C.R.T.S. students

Full-time	9	
Part-time	54	
		— 63
		Total 390

TABLE 2.

Class Enrolments.

Subject.	1st Term.	2nd Term.	3rd Term.
Preparatory Chemistry	25	14	12
Chemistry IA	30	22	20
Chemistry IB	5	4	3
Analytical Chemistry I	12	10	7
Analytical Chemistry II	7	7	7
Applied Chemistry	5	5	5
Metallurgy I	4	3	3
Metallurgy II	7	7	7
Metallurgy and Mineral Dressing	16	15	12
Mineral Dressing	7	7	7
Metallography	13	11	10
Preparatory Drawing	40	37	29
Drawing I	36	27	19
Survey Drawing II	9	8	6
Engineering Drawing IIA	26	20	18
Engineering Drawing IIB	1	....	....
Engineering Drawing IIC	3	3	4
Engineering Drawing IID	....	2	1
Mechanical Engineering I	8	8	6
Mechanical Engineering II	5	5	5
Practical Electricity	14	13	9
Electrical Engineering I	25	24	24
Electrical Engineering II	7	6	6
Internal Combustion Engines	33	28	23
Workshop Practice I	23	27	20
Workshop Practice II	12	10	9
Welding	22	22	23
Engine Driving	15	6	6
Structural Engineering I	8	8	7
Structural Engineering II	6	6	5
Hydraulics	9	9	9
Machine Design	6	5	5
Materials of Construction	9	9	9
Preparatory Mathematics	43	30	26
Mathematics IA	46	40	36
Mathematics IIA	43	38	34
Mathematics IIB	13	11	11
Applied Mathematics	17	14	12
Preparatory Physics	12	7	4
Physics IA	23	16	16
Physics IB	20	17	16
Trade Mathematics I.	37	24	19
Trade Mathematics II	7	4	5
Mining I	18	14	13
Mining II	12	11	9
Mining III	5	4	3
Surveying I	18	16	15
Surveying II	11	11	10
Preliminary English	10	8	6
Technical English	23	22	20
Preparatory Geology	21	18	13
Geology IA	8	8	8
Geology IB	19	15	13
Geology IIA	14	14	12
Geology IIB	9	9	8
Geology III	2	2	2
Preparatory English	9	9	7
Junior Geology	19	21	17
TOTAL CLASS ENROLMENTS, 1950	907	771	671
TOTAL CLASS ENROLMENTS, 1949	1,077	958	841

Revenue.

Revenue amounting to £923 11s. 1d. was received from students enrolled under groups 1 and 3, and from fees received for diplomas and certificates. Fees received for work done in the Metallurgical Laboratory and paid into a Trust Fund amounted to £127 15s. 6d.

Advisory Committee.

During 1950 the Advisory Committee met on nine occasions. Mr. T. A. Draper resigned from the position of chairman and Mr. J. H. C. Verran, Senior Inspector of Mines, was appointed in his place.

The committee recommended that a central library be built at the School, and the Chamber of Mines later agreed to provide a grant towards the cost of staffing the proposed library.

Further equipment was purchased from the Trust Fund and to the end of 1950 expenditure totalling approximately £3950 had been authorised from this fund. During 1950 a sum of £650 was set aside to provide a lecture note service during 1951. A further grant of £1,000 was promised by the Chamber of Mines for 1951.

Courses of Study.

The courses of study for 1950 remained similar to those in 1949. The Mine Manager's Certificate Course was commenced, and minor changes were made in the amount of chemistry required for the Associateship Courses in Mining and in Metallurgy. Engineering Drawing II was reorganised to provide for some time to be spent on design and to allow for a special course in surveying drawing.

Diplomas and Certificates.

The following Diplomas and Certificates were issued during 1950:

Associateship Course in Metallurgy	-
Associateship Course in Mining	6
Associateship Course in Engineering	4
Associateship Course in Mining Geology	-
Total	10
Assayer's Certificate Course	3
Surveyor's Certificate Course	4
Draughtsman's Certificate Course	-
Electrical Technician's Course	-
Industrial Chemist's Certificate Course	-
Geologist's Certificate Course	-
Electrician's Certificate Course	-
Engine Operation and Maintenance Course	-
Total	7

TABLE 3.

Summary of Examination Results, 1946–1950.

——	1946.	1947.	1948.	1949.	1950.
Class enrolments = A	1,331	1,834	1,498	1,129	946
Number of entries for Annual Examinations = B	880	1,196	1,097	750	579
B/A per cent.	66	64	73	66	61
Number of students passing at Annual Examinations as a per cent. of A	58	53	55	49	48
Number of students passing at Annual Examinations, as a per cent. of B	88	81	76	74	78
Number of students passing at Annual and Supplementary Examination, as a per cent. of A	60	55	57	52	50
Number of students passing at Annual and Supplementary Examination, as a per cent. of B	90	84	79	78	81

Annual Examinations.

The Annual Examinations were held from Monday, 30/10/50, to Tuesday, 14/11/50. At these examinations 579 entries for individual subjects were received, which represents 61 per cent. of the class enrolments received during the year. This figure is a decrease of five per cent. on the corresponding figure for 1949. Of the students who entered 78 per cent. were successful—an increase of four per cent. on 1949. In 10 subjects the loss was greater than 50 per cent. As for 1949 the preparatory subjects and some of the trade subjects were included in this group. The total number of subjects taught was 55.

A summary of examination results since 1946 is given in Table 3.

Supplementary Examinations.

At the end of 1949 the total number of supplementary examinations granted was 71. At the examinations, which were held from 13/2/50 to 17/2/50, the number of entries received was 48, and the number of passes was 33—68 per cent. of the entries received. This is an improvement on the previous year when only 43 per cent. passed.

Scholarships and Prizes.

The amended conditions for the Mines Department Scholarships, referred to in last year's annual report, became effective in 1950. No entries were received for the Entrance Scholarships and only one for the Senior Scholarship. The Senior Scholarship was awarded to R. V. Field, a pupil of the Eastern Goldfields High School. Field later accepted a cadetship at the School, and could not therefore hold his scholarship. The conditions for the Entrance Scholarships were further amended during the year, and the subjects for the examination are now Preparatory Mathematics, Preparatory Chemistry, and Preparatory Physics.

No student was eligible for either of the Robert Falconer Prizes, referred to in last year's annual report, and no award was made.

Two new scholarships were founded for students at Norseman—the Reg. Dowson Scholarships. These will be referred to in more detail in the section of this report referring to Norseman.

Commonwealth Reconstruction Training Scheme.

Trainees enrolled under this scheme continued to attend the School both as full-time and as part-time students. Details are given below:

	1949	1950
Full-time	53	9
Part-time	52	54

Of the nine full-time trainees two had further training time available to them, and were recommended to full-time training in 1951. Of the other seven trainees two completed their courses of study and the remaining five either had supplementary examinations (2) or still required some subjects to complete. Two other students, who had been training as part-time students, were recommended for full-time training, but elected to continue as part-time students.

Services to the Public.

During 1950 the School continued to provide a number of services to the public other than its teaching activities.

During the year 46 samples were received for investigation in the Metallurgical Laboratory and will be referred to again in a later section of this report. The Senior Research Metallurgist continued to give advice to anyone requiring it.

In 1950 the number of samples submitted by prospectors and others for determination or assay was 384—a decrease of 15 on the number submitted during 1949. Of the samples submitted 284 were assayed for gold. Other metals were determined in 14 samples. The remaining samples were described, and any minerals of value were indicated.

As in previous years the Director continued to act as Local Secretary for the University Annual Examinations and for the Junior and Leaving Examinations. Supervision and accommodation were provided for other examining bodies as required.

Various professional bodies such as the Australasian Institute of Mining and Metallurgy, the Institution of Engineers, the Institute of Mining Surveyors, continued to meet at the School.

Classes for High School Pupils.

By arrangement with the Director of Education and the Headmaster of the Eastern Goldfields High School special classes in sub-junior geology were held for second year High School pupils. Twenty were enrolled in this class and the arrangement worked satisfactorily throughout the year. In 1951 classes in both junior and sub-junior geology will be held.

Buildings.

In August work on the building from Wiluna was completed and the building brought into use. The building provides accommodation for metallography, for metallurgy, and at the present time for mineral dressing. Although not a new building it has been attractively finished, and is well suited for the purpose for which it was intended.

At about the same time the extensions to the workshop were completed and provided additional accommodation for workshop practice classes and for welding classes.

Work on the new lavatory block was commenced during the year but at the time of writing (March, 1951) this building has not been completed.

Generally the buildings are in good condition.

During the year lawns and gardens were planted in front of the School and its appearance from Egan Street considerably improved.

Requirements of the School.

In the Annual Report for 1948 the principal requirements of the School were listed. During 1949 some progress was made with most of them, and during 1950 most of these projects were completed or nearly so. Progress is recorded in the following paragraphs.

During 1950 the electrical installations at the School were re-organised and much of the School was rewired. Alternating current is now available in the Wiluna building, in the workshop, in the main engineering block of buildings, in the engine room and at other points throughout the School. This is a very big improvement. Excellent lighting has been installed in the drawing office.

As previously recorded the Wiluna building was completed during August. Because of the need of building material for more urgent work no progress has been possible with the proposed mineral dressing laboratory to be erected at the rear of the Wiluna building.

During the year further progress was made with the re-organisation of the workshop. The semi-universal grinding machine previously ordered was received and a new radial drill was installed. Independent drives were fitted to three lathes. The welding shop was extended and two additional electric welders were purchased. Generally the equipment in the shop is in good condition. Further improvements will be made during 1951.

Further equipment was received for the electrical engineering laboratory and installed during the year.

Tenders were called for the alterations to the fume cupboards in the chemical laboratories towards the end of the year, but to the time of writing (March, 1951) no tender had been accepted. This work is very essential and it is hoped that it will be completed during 1951.

Late in 1950 further consideration was given to the need for a library and a proposal submitted to the Department for consideration. The present proposal is that the library should not only be available to students, but also to industry. Financial support to provide staff has been promised by the Chamber of Mines.

The office is becoming over-crowded and there is a need for a store room and for a strong room.

The main outstanding requirements of the school are therefore as follows:—

(i) A mineral dressing laboratory for the use of students.

(ii) New fume cupboards, with mechanical ventilation, in the chemical laboratories.

(iii) A central library, and full-time staff.

(iv) Improved office accommodation.

Metallurgical Research Laboratory.

During 1950 the number of investigations received was 46, an increase of nine by comparison with 1949. Seven investigations were cancelled and of the remainder 24 had reference to gold, 12 to other metals, and three to non-metallics.

During the year 34 reports were issued and all work outstanding from 1949 was completed. At the end of the year 10 investigations were awaiting completion. Work on most of these had commenced and except for those intentionally held up, all should be completed early in 1951. This is quite satisfactory and credit is due to the Senior Research Metallurgist and to other members of the staff of the laboratory for work done during the year. A list of reports issued during 1950 is given in Appendix 1. Some information about the more extensive investigations is given in the following paragraphs:—

Report No. 412—"Investigation into the removal of arsenical minerals from Broken Hill gravity concentrates." This investigation involved the successful application of agglomeration tabling to granular lead concentrates for the removal of arsenical minerals.

Report No. 403—"Investigation of flotation tailings from Emperor Gold Mining Company, Fiji." This involved extensive infrasizing and superpanning work on flotation tailings to determine gold and sulphide sulphur distribution.

Report No. 437—"Tests to determine a method of treatment of ore from Sterling Gold Mines, Marble Bar, W.A." A comprehensive investigation involving straking, gravity concentration and cyanidation work on a gold ore containing copper and lead. Regard had also to be paid to the isolated locality of the mine.

Report No. 438—"Treatment tests on tailings dump of late Menzies Consolidated Ltd., Yunndaga, W.A." This included detailed agitation cyanidation and filtration tests of these tailings with economics as the major consideration.

In addition to the above 284 gold assays and 14 analyses for other metals were made in the laboratory for prospectors without charge.

No major additions to the equipment were made during the year, but some reorganisation of existing equipment was made and a comprehensive plan for future development was prepared. This plan involves the sub-division of the existing building and the addition of one new bay and is under consideration at the present time.

Towards the end of the year approval was given for the staff of the laboratory to be increased by one officer, who will be engaged mainly on chemical work.

2.—School of Mines, Norseman,

The total number of students enrolled during 1950 was 55—a decrease of 23 by comparison with 1949. This decrease was offset to some extent by the 18 State School children enrolled for special courses. By arrangement with the Education Department special classes in sub-junior science subjects were provided for these children. During 1951 this scheme is to be extended to provide both junior and sub-junior classes. Details of enrolments, not including State School children are given in Table 4.

TABLE 4.

Enrolment, Norseman.

Year.	1st Term.		2nd Term.		3rd Term.	
	Individual.	Class.	Individual.	Class.	Individual.	Class.
1948	96	165	84	122	89	139
1949	71	139	65	128	57	113
1950*	50	97	46	89	41	75

* State School children not included.

The revenue received was £65 10s. As in previous years many students were under 21 and did not pay class fees. Other students were returned servicemen and exempt from class fees. Five C.R.T.S. students were enrolled at Norseman.

TABLE 5.

Summary of Examination Results, 1946–1950.

——	1946.	1947.	1948.	1949.	1950.
Class enrolments = A	80	54	130	130	78
Number of entries for Annual Examinations = B	57	47	107	81	47
B/A per cent.	71	87	82	62	60
Number of students passing at Annual Examinations, as a per cent. of A	51	72	59	47	55
Number of students passing at Annual Examinations, as a per cent. of B	72	83	81	77	91
Number of students passing at Annual and Supplementary Examinations, as a per cent. of A	51	72	68	50	56
Number of students and Supplementary Examinations, as a per cent. of B	71	83	85	81	93

Throughout the year Messrs. O'Brien, Wood, Denham, Collin, Rose, Dodd, Clarke, and others for short periods acted as part-time instructors and gave good service to the School. The School at Norseman would not be possible without the assistance given by members of the part-time staff.

The number of School of Mines subjects taught at Norseman during 1950 was 18. This does not include the sub-junior science subjects provided for the State School children. The annual examination results were quite satisfactory. At these examinations 60 per cent. of the students enrolled sat for the examinations and of these 91 were successful—a figure which compares more than favourably with the corresponding figure of 78 per cent. in Kalgoorlie. A summary of examination results for 1946 to 1950 is given in Table 5.

Two scholarships, known as the Reg. Dowson Scholarships, have been founded by Mr. J. Dowson and Miss G. Dowson in memory of their brother Mr. Reg. Dowson, who was the first full-time instructor at Norseman, and who died there in November, 1949. The scholarships will be awarded annually to students enrolled at Norseman, and will each be valued at £12 10s. The first awards based on the annual examination results for 1950 were made to E. J. Lea and to R. K. Harris.

Minor improvements have been made to the building throughout the year and it is in a satisfactory condition. The grounds were improved by planting grass in front of the School and some trees at the side. No additions were possible during the year.

As in previous years Workshop Practice I and II, and Welding I and II were held in the workshops of the mines at Norseman, and the thanks of the Department are due to the mining companies for their assistance.

The Advisory Committee, with Mr. Dutton as chairman, continued to take a lively interest in the affairs of the School. Towards the end of the year two new members, Mr. W. Sherrell, representing the Australian Workers' Union, and Mr. W. A. Judge, representing the Amalgamated Engineering Union, were added to the Committee. As a large number of apprentices attend the School it was felt that these two unions should be represented.

Acknowledgments.

In conclusion I would like to acknowledge the assistance given by the Registrar, Mr. Lumb, in the preparation of material for this report. Throughout the year the staff both at Kalgoorlie and at Norseman have given good service to the students and to the School. Valuable assistance has been given by the Advisory Committees at Kalgoorlie and at Norseman.

R. A. HOBSON,
Director, School of Mines.

APPENDIX 1.

List of Reports Issued by the Kalgoorlie Metallurgical Laboratory during 1950.

(Where no information is shown against a number, no work has been done or is in progress.)

No.	Report.	Work Done.
399	Old Louden Mill, Irvinebank, Queensland	Screen analysis of tin tailings.
403	Emperor Gold Mines, Vatakoula, Fiji	Investigation of flotation tailings.
407	Flinder's Range Silver-Lead Co., Blinman, South Australia	Recovery tests on lead ore.
412	Broken Hill Associated Smelters, Port Pirie, S.A.	Arsenic removal from lead concentrates.
426	T. K. Bennett, G.M.L. 5822, Coolgardie, W.A.	Cyanidation of ore.
432	Democrat Mine, Linden, W.A.	Cyanidation of tailings.
435	Oma & Walsh, G.M.L.'s 679J, 681J, Wiluna, W.A.	Treatment of ore.
436	Paringa Mining & Exploration Co., Kalgoorlie	Investigation of flotation tailings.
437	Sterling G.M., Marble Bar, W.A.	Method of treatment of ore.
438	Hildich and Roberts, Yunndaga, W.A.	Cyanidation of tailings.
439	A. J. Hyman, Lake Darlot, W.A.	Treatment of ore.
440	Croesus Proprietary Treatment Co., Kalgoorlie	Investigation of flotation tailings.
441	Cancelled.	
442	Mt. Masson Tin Mining Co., Darwin, N. Territory	Determination of tin ores.
443	F. Lawrence, Riverina, via Menzies, W.A.	Cyanidation of tailings.
444	E. W. High, Mt. Monger, W.A.	Preparation of talc.
445	Calyerup Creek Gold Prospecting Co., Ongerup, W.A.	Treatment of ore.
446	Cancelled.	
447	L. E. Sears, Day Dawn, W.A.	Assays of samples.
449	Mines Department of W.A.	Assays of samples.
450	T. D. Scott, Kalgoorlie	Sizing analysis.
451	T. J. Hernesniemi, Northampton, W.A.	Assay of lead ore.
452	Cancelled.	
453	G.M.L. 1725N, Gabanintha, Murchison Goldfield, W.A.	Gravity concentration of battery tailings.
454	J. P. Hehir, Kalgoorlie	Wolfram determination.
455	Twos and Threes Lease, Marvel Loch, W.A.	Treatment of ore.
456	Cancelled	
457	R. Ibbotson, Uaroo, Ashburton Goldfield	Lead and silver determinations of sample.
458	Big Bell Mines, Ltd., Big Bell, W.A.	Infrasizing of tailing.
459	Mines Department of W.A.	Assays of samples.
460	Northampton Mining & Development Co., Northampton	Method of concentration of lead tailings dumps.
461		
462	R. Ibbotson, Uaroo, Ashburton Goldfield, W.A.	Lead and silver determination of sample.
463	Moonlight Wiluna Gold Mines, Ltd., Timoni Lease, Mt. Ida	Investigation of tailings.
464	Cancelled.	
465	Lakewood Firewood Co., Lakewood, W.A.	Tests on boiler feed water.
466		
467	Cancelled.	
468	R. Ibbotson, Uaroo, Ashburton Goldfield, W.A.	Lead and silver determinations.
469	Daisy Gold Mine, G.M.L. 5497E, Mt. Monger, W.A.	Treatment of tailings.
470		
471		
472		
473		
474	Sterling Gold Mine, Marble Bar	Treatment of ore sample.
475	R. Ibbotson, Uaroo, Ashburton Goldfield, W.A.	Lead and silver determinations.

Division VI.

Annual Report of the Inspection of Machinery Branch of the Mines Department for the Year 1950.

OPERATIONS UNDER THE INSPECTION OF MACHINERY ACT, 1921-1950.

ANNUAL REPORT OF THE CHIEF INSPECTOR OF MACHINERY AND CHAIRMAN OF THE BOARD OF EXAMINERS FOR ENGINE-DRIVERS FOR THE YEAR ENDED 31st DECEMBER, 1950, WITH STATISTICS.

The Under Secretary for Mines:

For the information of the Hon. Minister for Mines I submit the report of the Deputy Chief Inspector of Machinery in the administration of the Inspection of Machinery Act, 1921-1950, for the year ended 1950.

JOHN S. FOXALL,
Chief Inspector of Machinery.

SECTION 1.

INSPECTION OF BOILERS, MAINTENANCE, ETC.

(See Returns Nos. 1, 2, 3,).

Under the Act "Boiler" means and includes—

(a) any boiler or vessel in which steam is generated above atmospheric pressure for working any kind of machinery, or for any manufacturing or other like purposes;

(b) any vessel used as a receiver for compressed air or gas, the pressure of which exceeds 30 lbs. to the square inch, and having a capacity exceeding five cubic feet; but does not include containers used for transport;

(c) any vessel used under steam pressure as a digester, and

(d) any steam jacketed vessel used under steam pressure for boiling, heating, or disinfection purposes.

It also includes the setting, smoke stack, and all fittings and mountings, steam and other pipes, feed pumps and injectors, and other equipments necessary to maintain the safety of the boiler.

Return No. 1 shows the type and country of origin of the 196 boilers which were registered during the year. All the boilers shown in the West Australian column are of new construction and most of the boilers from elsewhere are also of new construction.

During the year there were no boilers of greater than 6 horsepower manufactured locally. The four water tube boilers indicated as well as the vertical stationary boilers which are listed, have been manufactured to supply the needs of dairymen, drycleaners, bakeries and vulcanizing establishments.

The six digesters which have been imported from Norway, are for use at a whaling station at Carnarvon.

The majority of the water tube boilers listed in the Eastern States column have been made by the Presha Engineering Co. (Vic.) Pty., but two of them are Babcock and Wilcox water tube boilers which have been erected at the Shannon River Mill which is under the ownership of the State Saw Mills Department.

RETURN No. 1.—SHOWING THE NUMBER OF BOILERS OF EACH TYPE, AND COUNTRY OF ORIGIN OF NEW REGISTRATION FOR THE YEAR ENDED 31st DECEMBER, 1950.

Type.	Country of Origin.							Total.
	United Kingdom.	Germany.	U.S.A.	Norway.	Eastern States.	Western Australia.	Unknown Sources.	
Cornish	....	....	....	....	....	....	....	....
Vertical Stationary	....	....	....	....	7	16	....	23
Vertical Multi. Stat.	....	....	1	....	....	1	2	4
Vertical Port.	....	....	....	....	....	1	....	1
Locomotive	....	1	....	....	....	3	....	4
Return Multi. Stat. Underfired	....	....	....	....	1	....	....	1
Gas Generator	1	....	....	....	....	....	....	1
Water Tube	1	....	....	....	10	4	....	15
Sectional	....	....	....	....	1	....	....	1
Digester	....	....	....	6	3	6	1	16
Vulcaniser	....	....	....	....	10	2	....	12
Steam Jacketed Vessel	....	....	....	....	4	18	3	25
Steriliser	....	....	....	....	4	16	1	21
Air Receiver	10	....	2	....	13	26	12	63
Gas Receiver	....	....	....	....	2	6	1	9
	12	1	3	6	55	100	20	196

RETURN No. 2.—SHOWING CLASSIFICATION OF VARIOUS TYPES OF USEFUL BOILERS IN PROCLAIMED DISTRICTS ON 31st DECEMBER, 1950.

Types of Boilers.	Districts Worked from PERTH.	Districts Worked from KALGOORLIE.	Totals.	
			1950.	1949.
Lancashire	44	53	97	97
Cornish	152	459	611	515
Semi-Cornish	11	37	48	48
Vert. Stationary	416	348	764	741
Vert. Portable	67	16	83	85
Vert. Multi. Stat.	51	25	76	73
Vert. Mult. Port.	17	3	20	21
Vert. Pat. Tubular	48	....	48	48
Loco. Rect. Firebox Stat.	88	62	150	153
Loco. Rect. Firebox Port.	257	64	321	323
Loco. Circ. Firebox Port.	139	8	147	147
Locomotive	84	37	121	118
Water Tube	339	115	454	441
Return Multi. Underfired Stat.	209	59	268	269
Return Multi. Underfired Port.	1	8	9	9
Return Multi. Int. Fired Stat.	51	12	63	62
Return Multi. Int. Fired Port.	2	....	2	2
Egg ended and other types not elsewhere specified	373	33	406	387
Digesters	264	9	273	259
Air Receivers	923	523	1,456	1,391
Gas Receivers	25	....	25	15
Vulcanisers	346	10	356	344
Steam Jacketed Vessels	458	13	471	459
Total Registrations Useful Boilers	4,365	1,894	6,259	6,107
Total Boilers Out of Use, 31st December, 1949	1,945	1,490	3,435	3,415

RETURN No. 3.—SHOWING OPERATIONS IN PROCLAIMED DISTRICTS DURING YEAR ENDED 31ST DECEMBER, 1950.

(Boilers Only.)

Types of Boilers.	Districts Worked from PERTH.	Districts Worked from KALGOORLIE.	Totals.	
			1950.	1949.
Total number of useful boilers registered	4,365	1,894	6,259	6,107
New boilers registered during year	189	7	196	246
Boilers reinstated	1	....	1	....
Boilers converted	1	....	1	....
Boilers inspected—				
Thorough	2,427	404	2,831	2,716
Working	441	9	450	315
Boilers condemned during year—				
Temporarily	10	1	11	22
Permanently	33	1	34	28
Boilers sent to other States during year	....	....	....	2
Boilers sent from other States during year	51	....	51	....
Transferred to other Departments	2	....	2	3
Transferred from other Departments	4	....	4	2
Number of Notices for Repairs issued during year	595	47	642	516
No. of Certificates issued including those issued under Section 30 during the year	2,420	404	2,824	2,692

Return No. 2 shows the number of boilers in proclaimed Districts as 6,259 as compared with 6,107 for year ended 1949. The number of out of use boilers for 1950 being 3,435 as compared with 3,415 for 1949.

Quite a number of these out of use boilers are still in serviceable condition but there are several obstacles in the way of them being brought back into commission. In many instances they are some distance from the railway and pressures are low as compared with what is required today. Many of these out of use boilers are of the Lancashire and Cornish type and owing to difficulties in arranging for and meeting cost of transport they will remain where they are unless they are very urgently required by someone and cost is not considered an obstacle.

Return No. 3 shows the operations concerning boilers for the year ended December, 1950.

Maintenance etc.

There are quite a number of locomotives registered under the Inspection of Machinery Act which are used in the saw-milling and mining industries and as all the boilers attached to these locomotives are fitted with copper fireboxes and brass tubes, the problem of repairs is going to become an increasingly difficult one.

It is admitted that steel fireboxes for railway locomotive boilers is now a well established practice on most of the railways operating throughout the world today and they are proving reasonably satisfactory.

The use of steel for fireboxes of locomotive boilers used on privately owned railways has disadvantages which are not so pronounced in connection with State-owned railways. For instance inferior quality of boiler feed water used in some of the privately owned locomotive boilers where feed water treatment plants are non-existent would probably cause a steel firebox to become a mechanical headache for the repair staff. Then again a steel firebox has not the lasting qualities of a copper firebox and therefore heavy repairs would become more frequent which, to a repair shop not suitably equipped for this class of work, would become a major problem.

Most of the locomotives in use on private lines have the firebox crowns girder stayed, which has the distinct disadvantage of limiting the amount of water covering the crown of the firebox and promotes building up of scale in rather confined spaces, which tends to overheating of the crown sheet. When it comes to fitting new steel fireboxes the opportunity will be taken where possible to dispense with the girder type of crown staying and radial stays suitably designed will be used instead.

SECTION 2.

Explosions and Interesting Defects.

I have only one major failure of a vessel to record. This concerns a 250 hogshead cooker made by a local engineering firm during 1950 for a brewery.

This vessel is 18ft 4in. dia. with a jacketed bottom and the radius of concave bottom being equal to the dia. i.e. 18ft. 4in.

The vessel was designed to work at 40 p.s.i. in the jacket.

The design of this vessel first sent in by the owners was not approved. Under departmental direction the number of space stays was nearly doubled, the size of the space stay was altered and the method of securing the stays specified.

When computing the inner bottom, great discrepancy was found between the pressure allowable by the use of the S.A.A. code and by Hiller. The use of the S.A.A. formula gave a much higher pressure than Hiller. The margin determined by the S.A.A. codes G214 was retained and the working pressure of the vessel computed accordingly.

After completion of manufacture this vessel was tested by hydraulic to 60 p.s.i. without any sign of movement being noticed.

It was erected at the brewery and placed on trial for three weeks under the direction of the Chief Engineer and his assistant who both exercised great care during the warming up periods and no trouble was experienced.

The day it was placed in active commission the control valves were handled by a brew-house hand and during the warming up period the inner vessel failed without any warning. Nearly half the inner bottom was affected. About one-third came up in a tremendous bulge, tearing the stays out of the inner vessel plating. No stay broke.

In six other places between the outermost ring of stays and the flange of the bottom the plate had come up between the stays, to a lesser degree.

During the time this vessel was on trial it was cleaned and examined every day and no weaknesses or distortions were noticed.

It appears certain that the distortions of the plate took place simultaneously and were the result of a very severe form of water hammer due to improper handling of the control valves.

This vessel was fed from 160 p.s.i. steam line through a reducing valve and protected with a low pressure safety valve and provided with usual drainage facilities for getting rid of the condensate.

The vessel has been repaired by cutting out all affected parts, electric welding in new parts and complete renewal of all stays with an additional row at the extreme outside.

Since repaired steam has not been supplied to the jacketed portion of the vessel, heat being transmitted by medium of steam coils.

During the year eight "Presha" boilers fitted with steel tubes were placed in commission at a whaling station at Babbage Island near Carnarvon. After a few weeks work it was found necessary to renew the tube assembly of all boilers.

From investigations made by an officer of this Department it appears that the boiler feed water had a high salt and other solids content and was also very sandy. This was further aggravated by the fact that non return valves were not fitted on the steam line from the boiler to the digester with the result that whale oil and meat went over into the tube assembly.

Non return valves have now been fitted and an attempt will be made to correct the feed water.

The mishap to the boilers was rather unfortunate and does not in any way detract from their usefulness, when handled properly.

During the year a condenser used with an air conditioning plant in which Freon is employed as a refrigerant failed by completely blowing out one end.

RETURN No. 4.—SHOWING CLASSIFICATION ACCORDING TO MOTIVE POWER OF GROUPS OF MACHINERY IN USE OR LIKELY TO BE USED IN PROCLAIMED DISTRICTS AND WHICH WERE ON THE REGISTER DURING THE YEAR ENDED 31ST DECEMBER, 1950.

Classification.	Districts Worked from PERTH.	Districts Worked from KALGOORLIE.	Totals.	
			1949.	1950.
No. of Groups driven by steam engines	403	525	968	928
No. of Groups driven by oil engines	1,555	1,084	2,352	2,639
No. of Groups driven by gas engines	63	195	256	258
No. of Groups driven by compressed air	....	62	62	62
No. of Groups driven by electric motors	18,552	4,154	20,399	22,706
No. of Groups driven by hydraulic pressure	3	....	4	3
	20,576	6,020	24,041	26,596

RETURN No. 5.—SHOWING OPERATIONS IN PROCLAIMED DISTRICTS DURING YEAR ENDED 31ST DECEMBER, 1950.

(*Machinery Only.*)

Classification.	Districts Worked from PERTH.	Districts Worked from KALGOORLIE.	Totals.	
			1949.	1950.
Total registrations useful machinery	20,576	6,020	24,042	26,596
Total inspections made	16,194	3,349	14,285	19,543
Certificates (bearing fees)	4,183	584	3,379	4,767
Certificates (steam without fees)	28	21	38	49
No. of extension certificates issued under Section 42 of the Act	....	....	....	....
Notices issued (Machinery dangerous)	351	9	332	360

RETURN No. 6.—SHOWING CLASSIFICATION OF LIFTS ON 31ST DECEMBER, 1950.

Types.	How Driven.	Totals.	
		1949.	1950.
Passenger	Electrically driven	196	196
	Hydraulically driven	1	1
Goods	Electrically driven	99	99
	Hydraulically driven	3	3
	Belt driven	4	4
Service	Electrically driven	43	45
		346	348

This condenser was one of a set of four and measured 4ft. 2in. long x 7in. internal dia. with a shell of ¼in. thickness and ends of ½in. thickness slightly dished concave to pressure. These condensers are subjected to the pressure imposed by the compressors.

This failure is attributed to faulty design together with defective workmanship.

The cross section of the fillet weld of end plate to shell nowhere exceeded ½in. adhesion to the shell.

It is understood that these condensers were constructed somewhere in the Eastern States.

As the capacity was not in excess of five cubic feet they were not subject to registration under the Inspection of Machinery Act.

Extensive damage was caused to associated equipment and surrounding enclosure and flying debris slightly injured two members of the staff.

The condensers have now been repaired and altered in a satisfactory manner under the direction of this Branch of the Mines Department.

SECTION 3.

Inspection of Machinery.

(See returns Nos. 4, 5 and 6).

The machinery groups in the register for the year 1950 totalled 26,596 compared with 24.041 for 1949 showing an increase of 1.554 groups.

Here follow returns 4, 5 and 6.

Accidents to Machinery.

The most sensational accident during the year is connected with 1,000 K.V.A. two ton electric smelting furnace which was in use at a large work-shop in the suburban area.

This furnace is of the power operated tilting type about 6ft. 0in. high x 8ft. 0in. dia. made from ¼in mild steel plate and lined with the usual firebricks.

This furnace had already supplied two ladles of molten metal and whilst a third ladle full was being poured, the tilting gear failed and allowed the furnace to turn right over when the water cooling pipes carried away, with the result that molten metal and water ran into the slag pit.

A violent explosion immediately followed which almost wrecked the machine. Three men were injured, one suffered from burns to the head, face and shock, another man suffered from burnt scalp, forearm and legs and the other man suffered from a pierced ear drum.

Had it not been for the fact that the force of the explosion was upwards and confined by a pit there would have been more casualties and perhaps a fatality or two.

In the rebuilding of the machine, the tilting gear was made more robust.

With the machine in its original state it was provided with limit cut out controls to prevent the motor from over tilting the furnace. These were replaced when the machine was rebuilt.

During the year a 3-ton Smith steam crane, whilst travelling over the Town Jetty viaduct in connection with the Albany Harbour toppled over into about three feet of water. The crane driver was able to jump clear before the crane left the viaduct and escaped without injury.

The accident was caused through a broken chassis axle.

The crane was extensively damaged and was sent back to the metropolitan area for repairs.

During the year a 150 h.p. six cylinder Crossley diesel engine fractured a web at No. 3 crank after about two years of service at a country flour mill. This engine was registered under the Inspection of Machinery Act and was insured with the Queensland Insurance Co., whose engineer inspected the engine every three months and checked all alignment. The maximum out of alignment was never more than three-quarters of 1/1000th and that was at No. 5 crank. The engine was last checked about one week before the failure took place.

A new crank shaft is on order from England and the engine will not be dismantled until the crank arrives in this State.

At present it cannot be determined what caused the fracture but it is assumed that it may have been the result of a faulty forging.

SECTION 4.

Prosecutions for Breaches of the Act.

During the year there were no breaches of the Act to record.

SECTION 5.

Accidents to Persons.

Return No. 7 includes only those accidents caused by working machinery subject to the provisions of the Act which are classed as serious, that is, those which prevented the injured person from following his or her usual occupation for a period of two weeks or more. Accidents which occurred in timber mills which are subject to the provisions of the Timber Industry Regulation Act 1926 are not included.

It will be noticed that five fatal accidents are recorded in a total of 85 listed.

Fatal Accident No. 1.

This accident is connected with an overhead travelling foundry crane which had been converted from hand power to electrically operated. At the time of the accident the crane had not been approved nor certificated by this Branch of the Mines Department.

From inquiries made it appears that a bearing in one of the long travel wheels had cut out and after a new bearing had been fitted the deceased person went up to grease the crane and after finishing the greasing operation he reached over the trolley wires to put in the isolating switch and immediately collapsed.

A workman on the floor of the foundry noticed his plight and rushed to the end of the foundry and switched off the main switch.

As soon as the current was turned off the deceased person fell to the foundry floor. This man died soon after from collapse of the lung, caused by fracture of the ribs following a fall after an electric shock.

The trolley wires causing the shock ran the full length of the foundry and provided the feeder lines for another crane on the crane-way which is common to both cranes.

The crane that had been converted from hand power to electric was provided with an isolating switch to enable the other crane to be worked when this one was cut out.

The position of the isolating switch constituted a danger and did not have the approval of this Branch or the Inspecting Officer of the Electricity Commission.

An isolating switch has now been provided which is operated from ground or floor level.

Fatal Accident No. 2.

This accident concerns a lad of 16 years of age who died after tetanus had set in as a result of a crushed foot. This lad was engaged on a lozenge cutting machine and when sweeping away from under the machine he bumped into an extension guide bar about 130 lb. in weight which became dislodged and fell on his left foot. This machine is subject to annual inspection by this Branch and since the last inspection the machine had been removed to another part of the factory and the standard carrying the guide bar had not been secured to the floor, and the stability of the column was dependent on the base plate of the column.

In the previous position the column was securely anchored to the floor.

The neglect in not securing the column was an oversight on the part of the engineer and has now been attended to.

Fatal Accident No. 3.

This accident comes under the heading of winding engines and was actually caused by the driver of an underground hoist losing control of the machine and the descending kibble knocked a workman off a winze ladder whilst he was going down.

This man fell approximately 50 feet to the bottom of the winze and sustained serious head injuries which proved fatal.

The hoist is a quick safety type and is fitted with a secondary brake of band design and is belt driven by a 5 h.p. electric motor.

From the evidence obtained the driver acted wrongly by operating the hoist when he knew there was a man on the ladder beneath the kibble.

At the time of the accident there were only five or six pieces of drill steel about 2 feet in length in the kibble.

When lowering the kibble to the level of the brace (a distance of about 5 feet) to load some long steel it is possible that the driver made some misjudgment and became excited and lost his nerve to such an extent that instead of applying the brake in a proper manner he let go of all controls attached to the winch and tried to stop the kibble from descending by gripping the rope with his hands.

An examination of the driver's hands proved this to be correct.

Immediately after the accident the winch was tested under all conditions and proved to be satisfactory for the purpose used.

The driver of the winch was an Italian.

Fatal Accident No. 4.

This accident concerns an air hoist used for gold mining.

A kibble was being raised when the hoist mechanism failed and the kibble ran back to the bottom of the shaft striking a man on the head with fatal results.

Fatal Accident No. 5.

This accident concerns a platman who was killed in the main shaft of the Perseverance Gold Mine, Kalgoorlie. The deceased person was crushed between the cage and the shaft timber at the surface brace.

From inquiries made it appears that another platman and deceased who were both working at the surface brace had completed lowering the day shift personnel and had proceeded to lower gear stacked on the brace.

The bottom deck of the cage was loaded with a reel of cable. It was intended to place an electric fan in the top deck and two bells were rung for the winder driver to lower the cage. Instead of lowering immediately the driver locked his brake and retired to the lavatory. On returning to the winding engine room he walked past the brace, had a few words with the two platmen, went into the engine room and started to lower to the cage top deck loading position.

The deceased person either slipped or on account of standing too close to the shaft was drawn into the cage and crushed under the platform on the top deck. He was killed almost instantly.

A fatal accident happened at the Mundaring Weir and was investigated by an officer of this Branch, but as it could not be regarded as a pressure vessel or machinery accident it has not been listed amongst the accidents showing in return No. 7.

A pipe 8¼in. inside diameter made up in sections was used to carry concrete from the concrete mixer to the part of the weir being built up.

After every batch of concrete is poured it is necessary to clean out the pipe and this is done by making a wad out of cement bags covered with a corn sack and blowing it through the pipe with compressed air.

At the time of the accident the wad became fast and permitted an air pressure of about 90 p.s.i. to accumulate behind it.

The wad suddenly came away and struck a workman in the face breaking his neck and killing him instantly.

As this accident demonstrated the fact that a blockage in the pouring pipe could create conditions tending to burst it, the bursting pressure of the pipe was computed and found to be 1900 p.s.i. allowing for 50 per cent. joint efficiency.

The maximum air pressure available being 100 p.s.i. provided a factor of safety of 19 for the pipe.

Reference to return No. 7 will show that circular saws have been responsible for the greatest number of accidents, with wire drawing machinery next and then follows belting and shafting.

Considering the number of pressure vessels and machinery groups registered under the Act, the number of accidents recorded for the year would appear to be reasonably light.

It is beyond doubt that it is impossible to prevent quite a lot of accidents that occur to people who work amongst machinery and it does not matter how well the machinery generally is guarded, there will always be accidents to record.

RETURN No. 7.—SHOWING NUMBER OF SERIOUS ACCIDENTS BOTH FATAL AND NON-FATAL WHICH OCCURRED IN PROCLAIMED DISTRICTS DURING THE YEAR ENDED 31ST DECEMBER, 1949.

(F) denotes FATAL.

	Woodworking and Furniture.	Leather Goods.	Metal Working and Engineering.	Printing and Allied Industries.	Flour Milling.	Laundry.	Fertiliser Manufacturing.	Food Drinks.	Refrigeration.	Chemical Industry.	Mining.	Power House.	Brewing.	Crown Seal Manufacturing.	Other.	Totals per Type of Machine.
Circular Saw	11	....	....	....	....	....	....	....	1	....	1	....	....	2	1	16
Buzzer	6	....	1	....	....	....	....	....	....	....	....	1	....	....	....	8
Thicknesser	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Leather cutting press	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Press (metal)	....	....	5	....	....	....	....	....	....	....	....	....	....	....	....	5
Press (other)	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Spindle moulder (shaper)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Pressure valve	....	....	....	....	....	....	....	....	1	....	1	....	....	....	....	2
Steam piping	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1
Belts, shafting, pulleys	....	....	....	....	1	....	2	1	....	1	....	....	1	....	1	7
Rolls	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1	2
Wiredrawing and wireworking machines	....	....	8	....	....	....	....	....	....	....	....	....	....	....	....	8
Nailing machine	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Emery wheel	1	....	....	....	....	....	....	....	....	....	1	....	....	....	....	2
Screw conveyor	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	1
Winding engine	....	....	....	....	....	....	....	....	....	....	3 (F)	....	....	....	....	3 (F)
Drilling machine (metal)	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	1
Electric crane	....	....	1 (F)	....	....	....	....	....	....	....	....	....	....	....	....	1(F)
Paper bag machine	....	....	....	3	....	....	....	....	....	....	....	....	....	....	....	3
Hoist	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	1
Concrete mixer	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Pipe manufacturing machine	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	3
Electric furnace	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Match box manufacturing machine	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Gearing	....	....	....	....	....	....	1	....	....	1	....	....	....	....	1	3
Food processing machine	....	....	....	....	....	....	....	4 (1F)	....	....	....	....	....	....	....	4 (1F)
Tanning drum	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Planing machine (metal)	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Fan	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Nail making machine	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Amusement machine (ferris wheel)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Beaters or stirers	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Totals per Industry	21	4	19 (1F)	3	1	1	4	5 (1F)	2	2	8 (3F)	1	1	2	11	85 (5F)

SECTION 6.

Examination of Engine Drivers, Crane Drivers and Boiler Attendants.

During the year the Board of Examiners granted 216 Engine Drivers Certificates composed of those for Winding Engines, 1st, 2nd and 3rd Class Steam Engines, Locomotives and Traction Engines and Internal Combustion Engines; 42 Crane Drivers Certificates which included those for Excavators only and 74 Boiler Attendants Certificates.

For the previous year (1949) the figures were 185, 39 and 101 respectively.

SECTION 7.

Amendments to Act.

At the latter end of 1950 the Inspection of Machinery Act, 1921-1950 had a successful passage through Parliament.

Under the 1921-1947 Act, the provisions for charging fees for machinery inspection was altogether out of step with present day trend of machine shop equipment and general layout.

The 1921-1950 Act will now provide for grouping of electrically driven units on a factory or workshop aggregate horsepower basis, and fees for inspection will be arranged accordingly.

The new scale of fees will react against the interests of this Branch from the point of view of finance but will give a considerable amount of relief to the owners of big establishments where a large number of electrically driven machines are installed.

The 1921-1950 Act also provides for the recognition of the position of the Deputy Chief Inspector of Machinery.

Under the 1921-1947 Act this particular officer did not seem to exist although he had been functioning for quite a considerable number of years.

SECTION 8.

Staff.

During the year the Senior Inspector of Machinery, Mr. Jordan, resigned to take up a position as Engineer to a well known mining company.

Mr. Winzar, the Inspector in charge of Kalgoorlie office, was appointed in Mr. Jordan's stead and Mr. Buttle, an Inspector attached to the metropolitan area, succeeded Mr. Winzar as Officer-in-Charge, Kalgoorlie.

I wish to thank all members of this Branch for the loyal support and assistance given to me during the year and also wish to record my appreciation of the co-operation and courtesy of all other Branches of the W.A. Government with whom it has been my privilege and pleasure to be associated.

My associations with Commonwealth officers leave nothing to be desired, and I wish to record the perfect understanding which exists between this Branch and the various Commonwealth Departments where interests are common to both.

ROBERT J. ROSS,
Deputy Chief Inspector of Machinery.

Annual Report of the Government Chemical Laboratories for 1950.

Contents.

Division VII.

Annual Report of the Government Chemical Laboratories.

The Under Secretary for Mines:

I have the honour to present for the Hon. the Minister for Mines, my report on the operations of the Government Chemical Laboratories for the year ending 31st December, 1950.

Staff.

The staff as at 31st December, 1950, numbered 57 and consisted of 43 professional, 7 clerical, and 7 general officers.

Accommodation.

The volume of work is increasing to such an extent that it will be necessary to seriously consider the provision in the near future of additional accommodation for the three older Divisions—Mineral, Mineral Technology and Geochemistry; Foods, Drugs and Toxicology; and Agriculture, Water Supplies and Forestry—as well as an increase for refectory, administration, stores, etc.

Arrangements are well in hand for the commencement of the erection of the Pilot Plant for the Industrial Chemistry Division. This plant will enable us to investigate our natural resources, minerals, forest products, clays, etc., to see if they can be beneficiated or treated to make them suitable for use in chemical industry, agriculture, building materials, etc.

Administrative.

There was considerable increase in the number of samples received for analysis and examination this year. The total number received by all Divisions was 11,814 as against 8,149 for last year. This was largely due to the increase in our activities in connection with work for the Metropolitan Water Supply, Sewerage and Drainage Department in connection with H_2S generation, etc., in sewers; the Agriculture Department; and the continued search for new water supplies for farmers in the agricultural districts. The volume of work of an advisory nature for other Government Departments and general public continues to increase from year to year especially in application to chemical technology in industry.

Foods, Drugs and Toxicology Division.

The bulk of the samples handled by the Food and Drug Division was received from the Police and Public Health and the Metropolitan Water Supply, Sewerage and Drainage Department, the latter in connection with the investigation into generation of hydrogen sulphide in the sewerage, and the consequent corrosion of cement mains.

Food samples were examined for compliance with the Food and Drug Regulations and Tender Board for purchase by Government Institutions. Chemical examinations were undertaken in connection with Swan River Pollution. The latter was further extended during the year to include the examination of mud samples. The result of these showed that chemically the river generally is quite reasonable with the exception of a few focal points. The several points where pollution is occurring are systematically being dealt with. Samples are examined for the Health Department and Factories Department, and advice is given concerning health conditions in factories, works, etc. A number of cheese, fruits, products, etc., were done for Department of Agriculture to check the manufactured products and chemical composition of natural fruit.

Agriculture, Water Supplies and Forestry Division.

The Agriculture Division handled a large number of samples during the year mainly for the Department of Agriculture, the chemical control of water supplies, and Agricultural waters from farmers, graziers, market gardeners, and orchardists. The materials examined for the Department of Agriculture included soils, pastures, cereals and various plant and tree materials and comprised work for its various branches, Plant Nutrition, Plant Pathology, Horticulture, Dairying, Entomology, etc. Fertilisers and Feeding Stuffs were examined for compliance with the Acts. The chemical research into the properties of W.A. tobacco was continued. Chemical examinations were done in connection with the study of growth in plants and the correction of deficiencies in growth so that better pasture plants can be produced for stock husbandry.

Mineral, Mineral Technology and Geochemistry Division.

The Mineral Division continues to carry out valuable work on mineral determinations and evaluation of ores for minerals of economic value and for scientific interest. This work is an important factor in the development of the mineral industry of the State. A number of new mineral localities have been recorded.

A magnetic separator has now been installed, and work which had been held over will be started upon in an attempt to get sufficient radioactive material for analysis.

During the year, in collaboration with the Department of Public Health and Factories Department, a microphotographic technique was developed to read the total number of particles in air samples using a konimeter as a sampling unit. By this means a much more accurate count is obtained with a subsequent better determination of the number of particles in the air where operatives are working. This Division is carrying out, from time to time, analyses of uranium-bearing ores from the Commonwealth Mineral Resources Bureau. Advice is given on the composition of metals and alloys which is an important part of our activities. They are examined for compliance with specifications and susceptibility to corrosion. This work is done for other Government Departments, State industries and the general public.

A number of industrial mineral deposits were examined for evaluation and suitability for use in various industries, such as iron smelting, ceramics, (including refractories and house bricks). Building materials for the Housing Commission were also examined to check their composition.

During the year two rock samples forwarded by the Massachusetts Institute of Technology, Department of Geology, were examined by this Division. The samples were distributed between a number of laboratories throughout the world to investigate the relative accuracy of various techniques determining the chemical composition of rocks. Comments were made on the excellent standard of the results of our analyses.

Fuel Technology Division.

During the year the Fuel Technology Division has done much valuable work, particularly in the advances made in its application to industry.

The survey of all working faces at Collie has been continued and during the year all faces were examined in detail. This will be continued as development proceeds.

A temporary annexe laboratory was established at Collie in October for the purpose of carrying out coal washing and blending tests. These are proceeding and preliminary results should be available next year. It is hoped that a permanent laboratory will be established as Collie to undertake the routine examination of coals so that a close check can be kept on all coal produced.

Progress in the manufacture of carburetted water gas from raw coal was advanced during the year with the help of the Fremantle Gas Company who have given us free access to their works for experimental purposes. This action is much appreciated.

Other valuable work has been done in boiler trials with Collie coal. The working facilities provided by the Government Railways, Colonial Sugar Refining Company and the Swan Brewery Company is thankfully acknowledged.

Work in connection with the use of Collie coal in cupola practice is more or less in the experimental stage. It is hoped to further continue this investigation with the co-operation of the State Engineering Works, to whom our thanks are also due.

Research into briquetting of Collie coal is receiving regular attention and it is hoped to finalise research on this project in the coming year.

The Fuel Technology Laboratory is now especially well-equipped and experienced in the technological uses of Collie coal, particularly in its application to gasification. From the point of view of value to the State it is essential that close co-operation be maintained between our Technical Research Officers and the works technical staff of Government undertakings.

Industrial Chemistry Division.

The work of the Industrial Chemistry Division has again been limited by the lack of proper facilities. It is hoped that the erection of the Unit Process Plant will be commenced in the coming year. This will enable the Division to undertake work of benefit to the establishment of chemical industry from our natural raw materials. Much work of a consultative nature has been done for State Industries and private Industries. The information service is functioning satisfactorily.

Investigations undertaken during the year were on insecticides manufacture, Sorrel cement, paints and marketable salt and the suitability of lime stone in the S.W. for Portland cement.

Table Showing Source of Samples for 1950.

Source of Samples.	No.
Chemical Laboratories	390
State Mining Engineer	23
State Batteries	289
Government Geologist	182
Explosives Branch	10
Interdepartmental Irrigation Committee	19
Interdepartmental Tobacco Investigation	198
Wood Distillation, Charcoal Iron and Steel Industry	7
Bureau of Mineral Resources, Atomic Mineral Survey	4
Department of Public Health	214
Department of Agriculture	1680
War Service, Land Settlement Scheme	68
Department of Works and Labour	449
Department of Industrial Development	15
Departmental Lime Sinter Commission	1
Corrosion Committee	9
Metropolitan Water Supply	5942
Fibrolite Pipe Committee	14
Royal Perth Hospital	23
Government Stores and Tender Board	48
Fisheries Department	3
Chief Inspector of Factories	1
Native Affairs Department	3
Education Department	2
Police Department—	
Coroners	237
Criminal Investigation Branch	32
Liquor Inspection Board	4
Free	412
Pay—	
Public	1344
Local Governing Bodies	10
Commonwealth Works and Housing	7
Aeronautical Inspection Directorate	23
Post Master General	1
Forests Department	4
Civil Aviation Department	10
Commonwealth Lighthouse and Navigation	1
Government Railways	31
Commonwealth Oil Refineries	6
State Housing Commission	10
Repatriation Commission	6
State Alunite Industry	6
Perth Hospital Construction	7
Main Roads Department	10
State Brickworks	11
British Phosphate Commission	33
W.A. University	6
State Electricity Commission	2
Chief Coal Mining Engineer	7
	11,814

FOOD AND DRUG DIVISION, 1950.

	Public Health Department.	Agriculture Department.	Metropolitan Water Supply.	Police and Coroner.	Police—C.I.B.	Police—L.I.B.	Government Stores and Tender Board.	Works and Labour Department.	Royal Perth Hospital.	State Mining Engineer.	Chief Inspector of Factories.	Explosives Branch.	Wood Distillation Charcoal, Iron Industry.	Fisheries Department.	Mineral Resources Bureau.	Free.	Pay—Public.	Pay—State Alunite Industry.	Pay—Repatriation Commission.	Pay—Commonwealth Oil Refineries.	Pay—W.A. Government Railways.	Pay—Civil Aviation Department.	Pay—State Housing Commission.	Pay—Aeronautical Inspection Directorate.	Pay—Commonwealth Works and Housing.	TOTAL.
Foods—																										
Butter	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Cheese	....	55	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	55
Cows Milk	40	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	40
Sausages	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Gelatine	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Pepper	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
S.R. Flour	....	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6
Foods (sodium)	8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8
Oranges	....	34	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	34
Edible Berries	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Tinned Apples	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Pickles	....	....	....	....	....	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Tomato and Chutney Sauce	....	....	....	....	....	....	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Tomato Soup	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Worcestershire Sauce	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Bread	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	....	....	....	....	....	....	4
Cocoa Butter (Nicotine)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Tablets (Milk Preservative)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Soya Bean Flour	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Rice (Contaminated)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Tea	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1
Fermented Wort	....	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Crayfish	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Apples (sprayed)	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Fruit Juice Cordials	65	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	65
Tallow	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	2
Salt	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7	1	2	....	....	....	....	....	....	....	10
Margarine	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Potato Crisps and oil	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Breafast Food (poison)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Icing Sugar (poison)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Human Toxicology—																										
Exhibits (for Poison)	7	....	....	129	21	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	157
Blood and Urine (Alcohol and CO.)	2	....	....	90	1	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	94
Anaesthetic	....	....	....	14	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	14
Animal Toxicology	....	27	....	4	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	33
Industrial Toxicology—																										
Urine	3	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	4	....	2	....	31	....	....	....	....	42
Rotosan—Air Purifier	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Sludge (Lead Joint Caulking)	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Walterisation Solution	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Human Hair (Furniss)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Wheat Dust and Konimeter	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Sewage—																										
Weekly Routine	....	....	2,308	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2,308
Investigational Survey	....	....	3,397	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3,397
Complete—Quarterly	....	....	10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10
River Pollution	....	....	....	....	....	....	....	288	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	228
Biological Filters	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Ocean Beach Survey	....	....	170	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	170
Trade Wastes	....	....	22	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	22
Murisol Solution	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2

Liquors—																															
Wine (Poison)											1																				1
Beer												1																				1
Whisky												1																				1
Rum												1																				1
Wine									24																						24
Cider									5																						5
Hop Beer												1																				1
Drugs and Medicines—																															
Ether (Supplies)														20																		20
Ether (Deteriorated)							1																									1
Couch Grass and Brew							2																									2
Tablets (Identification)														1																		1
Atropine Sulphate							2						1																			3
Mersalyl							2																									2
Pethidine							1																									1
Dangerous Drugs (Identification)							11																									11
Phenobarbitone							1																									1
Criminal—																															
Exhibits—Stealing Offence											2																					2
Suspected Poison (Rainwater)											2																					2
Extract Clothing (Missing Baby)							2																									2
Paint Scraping (Bicycle)											3																					3
Insecticides—																															
D.D.T. Concentrate							2																									2
Grape Storage Preparation									19																							19
Fluosilicate									2																							2
Lime Sulphur Spray									2																							2
Argentine Ant Bait							1																									1
Fly Spray													9																			9
Merpusan																								1								1
Grasshopper Bait									20																							20
Peaches and Foliage									2																							2
D.D.T. (Plates and Concentration)							7																									7
D.D.T. Spray							1																									1
Fluorine in Phosphates—Sheep urine, faeces and solution									60																							60
Oil Shale																						1										1
Petroleum Tests																							2									2
Cleansing Materials—																																
Mooval													1																			1
Zoak													1																			1
Soaps and Cleansers													12																			12
Floor Polish													10																			10
Water (Poison)														1										2								3
Water (Swan River)																2																2
Water (Fluorine)							18																	2								20
Coalmine Air															8																	8
Soils (for D.D.T.)									5																							5
Oils																										4				15		19
Cattle Dip									24																							24
Human Milk							12																									12
Explosives																	10															10
Wheat (Fungicide Treated)									2																							2
Latex																								1								1
Acetic Acid																		4														4
Ambergris																					1											1
Materials for Identification																														5		5
Flintkote (Waterproof)								1																								1
Powder (Identification)									2																							2
Oiled Apple Wraps									9																							9
Substance from Pine (Pearce)																															1	1
Fluorescent Tube																								1								1
Hat Band (? Rash)							1																									1
Pine Fruit Case Shooks									20																							20
Lineoleum Underlay															2																	2
Paint																														4		4
Crude Wool Grease																								1								1
Substance—Diesel Engine																								1								1
Hydraulic Fluid																														1		1
Turpentine																														1		1
100 Octane Fuel																											1					1
Mallet Bark																								4								4
Totals							207	325	5,912	237	32	4	48	292	23	8	1	10	4	2	1	10	20	2	6	4	31	1	4	22	1	7,207

AGRICULTURE DIVISION, 1950.

Material	Agriculture.	Works and Labour.	Metropolitan Water Supply.	Irrigation Committee.	War Service Land Settlement Scheme.	Departmental.	State Mining Engineer.	Education Department.	Native Affairs.	Corrosion Committee.	Public Health Department.	Industrial Development Department.	Government Geologist.	Fisheries Department.	Interdepartmental Tobacco Investigation.	Free.	Pay—Public.	Pay—Commonwealth Works and Housing.	Pay—Commonwealth Lighthouse and Navigation.	Pay—Civil Aviation.	Pay—Local Governing Bodies.	Pay—P.M.G's. Department.	Pay—Forests.	Pay—A.I.D.	TOTAL.
Water	156	146	28	19	68	2	5	2	3	....	18	3	1	1	....	14	1,137	6	1	9	10	1	1	1	1,632
Soils—																									
Plantation	173	....	....	....	....	....	....	....	....	....	....	....	....	....	198	....	....	....	....	....	....	....	2	....	373
Farm	73	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	75
Tennis Court	16	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	16
Sandy Peat	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	5
Fertilisers—																									
Copper Compound	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Limestone (Soil Dressing)	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	8
Fertiliser	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5	....	....	....	....	....	....	....	6
Potato Manure	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Super Untreated	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Super Sterilised	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Superphosphate	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Zinc Oxide	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Fertiliser Act Samples	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Fodders and Cereals—																									
Subclover	123	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	123
Linseed	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6
Lucerne	8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8
Elephant Grass	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Vetch	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Meadow Hay	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Pastures	258	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	258
Wimmera Rye Grass	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Tick Bean	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Lupins	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6
Wheat Plants	141	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	141
Barley Plants	12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	12
Oat Plants	47	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	47
Bamboo Shoots	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Dried Buttermilk	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Silver Beet	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Oat Grain	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Wheat Grain	12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	12
Peanuts	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Clover Seed	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Clover	15	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	15
Oaten Hay	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Wheaten Hay	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Baled Hay	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Oaten Chaff	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Tree Lucerne	7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7
Feeding Stuffs Act Samples	50	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	50
Meatmeal	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	2
Whalemeal	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	3

Whalesolubles	1																												1
Fruit Investigations—																													
Peach Leaves	3																												3
Vine Leaves and Prunings	54																												54
Mandarin Leaves	3																												3
Orange Leaves	5																												5
Citrus Leaves	2																												2
Apple Leaves	52																												52
Vegetable Investigations—																													
Potato Plants	3																												3
Cabbage Leaves	2																												2
Cauliflower	2																												2
Wheat, F.A.Q.	4																												4
Wheat Flour	2																												2
Wheat (Bulk Shipment)	5																												5
Methyl Alcohol-Water "Brine"											1																		1
Paper Extract Solution																			6										6
Tobacco Leaf	31																												31
Iron Oxide																			1										1
Totals	1,342	146	28	19	68	2	5	2	3	1	18	3	1	1	198	14	1,156	6	1	9	10	1	1	1	3,038				

MINERAL DIVISION, 1950.

Material.	Pay.	Free.	State Batteries.	Government Geologist.	Departmental—Director, Government Chemical Laboratories.	State Mining Engineer.	Industrial Development Department.	Fibrolite Pipe Committee.	Lime Sinter Investigation Committee.	Corrosion Committee.	Metropolitan Water Supply.	Royal Perth Hospital.	Agriculture Department.	Public Works Department.	Perth Hospital Construction.	Mineral Resources Bureau.	Pay—W.A. University.	State Brickworks.	British Phosphate Commission.	Main Roads Department.	State Housing Commission.	State Alunite Industry.	Forests Department.	Wood Distillation, Charcoal Iron and Steel Industry.	Total.
Alloys and Metals	4	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Corrosion	1	....	....	....	....	....	....	....	....	8	1	1	1	3	6	....	....	....	....	1	....	....	....	....	22
Ceramics—																									
Clays	2	8	....	....	4	....	....	....	....	....	....	....	....	....	....	....	....	11	....	....	....	....	....	....	25
Magnesite	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Firebricks and refractories	6	....	....	....	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10
Dolomite	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Kyanite	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Spongolite	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Natural Mineral Pigments—																									
Ochres and Oxides	2	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Metallic Ores and Minerals—																									
Beryllium	....	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Copper Ores	12	53	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	66
Gold Ores	61	74	....	....	....	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	140
Gold Copper Conc.	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Gold Slimes	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Gold Umpire	....	....	52	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	52
Gold Tailings	....	....	208	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	208
Heavy Sands	1	7	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	9
Iron Ore	2	6	....	34	....	....	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	48
Lead Ore	3	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Lead-Mill Products	12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	12
Chromite	....	8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8
Manganese	8	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	12
Columbite	....	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Tantalite	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Titanium	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Rutile	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Tungsten	8	7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	15
Tin Ores	2	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6
Cadmium	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Cobalt	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Tin Tantalite Conc.	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Monazite	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Minerals for R.A. Test	....	14	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	14
Uranium	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	....	....	....	....	....	....	....	....	3

Other Economic Ores and Minerals—																													
Oyster Shell Silt	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Alunite	....	....	....	....	....	....	....	....	....	....	....	....	20	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	20
Barite	....	....	....	....	....	....	....	2	....	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Bentonite	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Glauconite	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Garnet	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Graphite	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Limestone and Limesands	....	....	....	....	....	3	7	....	55	....	....	....	1	....	....	....	....	....	....	6	....	....	....	....	....	....	....	....	72
Phosphates	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	33	....	....	....	....	....	....	33
Potash Products	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4	....	....	....	4
Gypsum	....	....	....	....	....	2	7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	9
Mineral Spec. for Detn.	....	....	....	....	....	9	151	....	7	18	3	3	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1	....	193
Miscellaneous—																													
Caustic Lime	....	....	....	....	....	....	....	21	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	23
Water and Mud	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Construction and Building Materials	....	....	....	....	....	6	2	....	....	....	....	1	....	....	....	....	....	....	8	....	....	....	....	9	6	....	....	....	32
Salt from Cyaniding	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Blast Furnace Dust	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Balance Riders	....	....	....	....	....	....	....	7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7
Lignite	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Fibrolite Pipes	....	....	....	....	....	....	....	....	....	....	....	....	14	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	15
Health Hazard—																													
Mine Dusts	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Totals	....	....	....	....	....	152	387	289	97	32	10	12	14	21	8	2	1	2	11	6	3	6	11	33	10	6	4	1	1	1,119

General.

Two papers were accepted for publication during the year. One on "Modifications to the Gooderham Continuous Flow Gas Analysis Apparatus" in the Journal of the Society of Chemistry and Industry and the other "A Miniature Gas Calorimeter" in the technical paper "Fuel."

Mr. Hodgson, Analyst and Research Officer, Food and Drug Division, attended a conference held in Melbourne on 28th November, on "Hydrogen Sulphide Problems in Sewerage Installation." He later worked for several weeks in the Melbourne Water Board Laboratory on standard laboratory techniques.

Mr. A. Reid, Chief Industrial Chemist, visited Melbourne and Hobart at the end of the year with the Hon. H. S. Seward in connection with a superphosphate enquiry.

Mr. H. P. Rowledge, in March attended a meeting of the Australian Institute of Mining and Metallurgy held in Melbourne.

Mr. L. Brennan, Fuel Chemist and Research Officer, was transferred to Collie in October, to work on the washability of Collie coals at that centre.

H. P. ROWLEDGE,
Director.

FOODS, DRUGS, TOXICOLOGY AND INDUSTRIAL HYGIENE DIVISION.

Annual Report for the Year Ended 31st December, 1950.

By J. C. Hood, B.E.M., A.A.C.I., Deputy Government Analyst.

Food.

The number of samples of foodstuffs submitted during the year amounted to 223 of which 116 represented inspector's samples received from the Department of Public Health, the remainder being samples from the Department of Agriculture and the Government Tender Board.

Milk.

Milk samples received numbered 40, the greatest majority being samples suspected of having been adulterated by the addition of water. Whilst only three failed to comply with the legal standard for fat content, ten were deficient in solids not fat, but nearly all failed to comply with the freezing point requirements, some indicating the addition of an appreciable amount of water.

Cheese.

Fifty-five samples of cheese were received from the Department of Agriculture for determination of fat and moisture as a means of checking the products produced by cheese factories within the State.

All samples complied with the requirements and appeared to be of consistent quality throughout the year.

Fruit Products.

Oranges grown in various districts were submitted by the Department of Agriculture from time to time to ascertain by determination of acidity and juice content, the degree of maturity and suitability of the fruit for picking.

The ascorbic acid (vitamin C) content of 65 samples of bottled fruit juices and cordials being sold in Western Australia were examined for the Department of Public Health. These samples represented products of the Eastern States and local manufacture, some of which were of known date of bottling.

With few exceptions, the ascorbic acid contents were negligible even in the cordials made from citrus fruits much publicised as valuable sources of vitamin C. An immediate fall in ascorbic acid is incidental to the present methods of manufacture but continues rapidly after bottling in clear glass bottles when exposed to light.

A number of oiled paper wraps were examined in conjunction with experimental work being carried out in conjunction with the Department of Agriculture on "Scald" on Granny Smith apples.

Papers from various sources were extracted for total oil content and the nature of the oil examined and the characteristics determined. The base in all cases was essentially petroleum oils of a grade similar to liquid paraffin. Low saponification values of American papers indicated traces of saponifiable matter inherent to the petroleum stock or extracted from the paper. Higher saponification values of Swedish and Finnish papers suggested the presence of a vegetable or animal oil possibly to an extent of 5% and 2% respectively of the total oil content.

The papers, when freed from oil, appeared to be similar in composition and texture with slight variation in loading.

The continuation of grape storage experiments by the Department of Agriculture early encountered difficulty with manufactured sulphite tablets which contained only fractional amounts of available sulphur dioxide. Tests were undertaken with various powdered sulphites and sulphite-alum mixtures exposed in the cold store with the grapes. In cold storage the sulphur dioxide loss was fairly constant from the sulphite-alum mixture and to a lesser extent from sodium meta-bisulphite with potassium meta-bisulphite the most stable composition. At ordinary temperatures the decomposition of sodium bisulphite exceeded that of sulphite-alum mixtures.

The high moisture content of pine fruit case shooks in two shipments from Europe which arrived in a deteriorated condition owing to the development of mould was the subject of some investigation. Considerably higher moisture contents were shown near the outer edge of separate pieces tied in bundles, indicating the bundles had been wetted subsequent to bundling. Low salinity excluded the possibility of such wetting being due to sea water. It was subsequently ascertained that the shipments had been exposed to snow prior to loading.

Low Sodium Diets.

In order to obtain figures for Western Australia of the sodium content of various foods used in low sodium diets to control high blood pressure and renal deficiencies a complete day's diet was submitted for analysis by the Department of Public Health. The sodium content of the constituent foods and the complete diet gave figures slightly higher than those recorded in U.S.A.

Analyses of tea and salt-free bread were also examined for a Commonwealth Hospital also concerned with formulation of low sodium diets.

Suspected Poisoning by Rice.

Members of a family became ill on eating puddings made from a supply of rice which was part of a batch of 56 lbs. retailed by a local grocer. No other complaints were received from other customers.

Bacterial contamination was most improbable and the short incubation period suggested that, if the rice were at fault, some preformed toxin or chemical substance was responsible. Thorough examination failed to locate any chemical poison or contamination of the rice supply.

Soya Bean.

Severe sickness of a child on a soya bean diet followed when placed on a new supply of soya bean flour.

Analysis showed the sample to be undoubtedly soya bean of low carbohydrate content. Further investigation however showed considerable variations in both the whole beans sold and the prepared flours.

References from American sources indicate that soya bean used in the preparation of infant foods is confined to certain varieties and work is being carried on along these lines.

Human Milks.

There was a considerable falling off of the number of human milks examined this year for Infant Health Clinics, only 12 being submitted.

The compositions of many of these milks were abnormal, indicating the value of the analyses for corrective dieting.

Suspected Poisoned Foodstuffs.

Suspected contamination of a consignment of cocoa butter by nicotine sulphate during shipment from overseas during rough weather. Leakage was thought to have travelled from a distant part of the hold along angle iron.

No contamination or poison, however, was detected.

Miscellaneous Food Samples.

Amongst miscellaneous foodstuffs examined were, butter, sausages, margarine, gelatine, pepper, self-raising flour, tinned apples, pickles, tomato sauce and soup, crayfish and potato chips.

Government Tender Board.

In addition to the foodstuffs submitted for tender under the Provisions Schedule, 24 samples of soaps, cleansers and floor polishes were also examined under Government specifications.

The variety of uses to which soap powders and cleansers are now placed calls for additional specifications to meet the demands of altered washing techniques and kitchen mechanisation.

Fluorine in Water Supplies.

A systematic survey of the fluorine content of waters used for drinking and culinary purposes throughout the State, has been initiated by the Department of Public Health in collaboration with their dental officers as part of an investigation into the relationship of dental caries to the fluorine content of water. Rain waters collected from roofs and other catchments are also being examined as constituting sources of water almost exclusively used in areas not served by supply schemes.

The fluorine content of rain water collections is below 0.05 parts per million, and to date no waters from other sources in this survey have exceeded 0.6 parts per million.

Liquors, Wines, etc.

From the Liquors Inspection Branch only four samples were received during the year, two of which were beer for composition and alcoholic content and samples of rum and whisky adulterated with water.

Analyses of a number of samples of wine and cider and the accurate determination of pH of various vintages for the purpose of blending were made for the Government Viticulturist making in all a total of 29 samples. The form and quantity of sugars and dextrins in fermented wort for the manufacture of vinegar was also the subject of an investigation.

Drugs and Medicines.

Anaesthetic Ether.

Twenty samples of anaesthetic ether containing hydroquinone as a preservative, drawn from supplies to Government Stores and Royal Perth Hospital, were tested for the presence of peroxides and aldehydes as indicators of deterioration.

All samples complied with the British Pharmacopoeia tests for purity.

Drugs.

Eleven samples of hypodermic tablets were submitted for identification, consisting of hypnotic alkaloids and mixture of alkaloids. Whilst most were true to label, a few showed the presence of an alkaloid not named on the label.

A number of ampoules were also submitted for identification and estimation, these included pethidine hydrochloride, the assay of mersalyl ampoules and examination for substances reputed to cause pyrexia.

The assay of a supply of phenobarbitone to a Government Hospital gave all the characteristics and tests of the British Pharmacopoeia but possessed a melting point outside the permitted range.

An alleged cure for rheumatoid arthritis consisted of a dried sample of the common couch grass and a fluid decoction made from it. Examination failed to disclose the presence of any property additional to the well-known aperient and dieuretic properties of *Agropyrum repens* to which beneficial effects may be due.

Toxicology.

Human Poisoning Cases.

The total number of toxicological exhibits received in connection with real or suspected human poisoning cases was 157.

Of these Coroner's exhibits amounted to 129, representing a total number of fatal cases in which the following common poisons were found: arsenic, 3; chloral, 2; barbiturates, 6; strychnine, 3; A.B.C. liniment, 1; Lysol, 1; carbon monoxide, 1; and alcohol, 2. In 20 cases complete negative results were obtained, or materials identified which were inocuous or had no apparent significance with the fatality.

A further 13 exhibits were received as the result of investigations by the Criminal Investigation Branch into circumstances surrounding three deaths suggestive of poisoning, one of which was negative.

Seven specimens of cerebro-spinal fluid and urine were examined for the identification of barbiturates in patients admitted to Royal Perth Hospital in a state of coma.

Death under or following Anaesthesia.

Fourteen specimens of anaesthetics and allied materials impounded in suspected cases of death under or following anaesthesia were forwarded by the District Coroner. Whilst these consisted mainly of preservatised ether and ethyl chloride, in no case did the specimens show any indication of deterioration. Other anaesthetics local and intravenous, were found to be of the identity and concentrations stated.

In the case of a death following the administration of nitrous oxide and oxygen with preliminary medication, the gases and hypnotics, although not implicated, were examined and found to be of the British Pharmacopoeia standard of purity.

Blood Alcohol and Urine.

The systematic examination of blood and urine for alcoholic content initiated last year, from persons killed as the result of traffic accidents or having met violent deaths has been continued throughout the year.

Of the 65 bloods forwarded by the District Medical Officer, mostly from traffic accidents, the concentrations of alcohol found were:—

Negative	34
0 — 0.05 per cent. alcohol	4
0.05 — 0.1 per cent. alcohol	4
0.1 — 0.15 per cent. alcohol	3
0.15 — 0.2 per cent. alcohol	5
0.2 — 0.25 per cent. alcohol	4
Above 0.25 per cent. alcohol	11

Accepting the figure of 0.15 per cent. as the limit, 20 of these persons could be presumed to be definitely under the influence of alcohol.

The urines which, of course, indicate the alcohol being eliminated were generally of the same order as the blood samples.

Criminal Investigation.

No outstanding cases required the services of this Division during the year but of minor importance were two cases. The first referred to identifying powder marks on paraffin wax masks of the hands of a person alleged to have shot himself.

Only one spot was positive, the results being inconclusive as the revolver had a protective shield on the breech and the possibility of the deceased having been washed prior to examination.

The other inconclusive case was that of suspected suicide by shooting and subsequent recovery of the body after a number of days immersed in the ocean.

Two stealing offences required in the one case the identification and evidence regarding fluorescent substances used to mark notes and in the other the identification and comparison of paint spots and a superimposed surface involved in a charge of a stolen bicycle.

Extracts of stained portions of clothing of a man suspected of being associated with the abduction of a baby were examined for stercobilin or related pigments with negative results.

Following an aircraft disaster when the A.N.A. Skymaster "Amana" crashed with the immediate loss of 28 of the 29 occupants, the clothes of the pilot, who was thrown clear, were submitted for investigation, particularly for evidence of a preliminary fire or explosion or the presence of residuals of dangerous substances. Examination of the blood of deceased for alcoholic content was also made. Investigation of both exhibits yielded negative results.

Expert Evidence.

Expert evidence in Coroner's and other courts were tendered by myself as Deputy Government Analyst and Messrs. Southern, Sedgman and Houghton.

Animal Toxicology.

Twenty-one specimens in connection with animal poisoning were received of which nine represented viscera from accidental or malicious poisoning and four gave negative results. Six specimens, thought to be baits laid for domestic animals proved to be negative in three cases, the remainder all containing appreciable amounts of strychnine.

A considerable number of fatalities in sheep followed the use of a proprietary drench reputed to consist of carbon tetrachloride given in conjunction with copper sulphate, were found on analysis, to consist of approximately equal parts by weight of medicinal paraffin oil and tetrachlorethylene. The copper sulphate was of a technical grade of purity.

A sample of the drug phenothiazine normally effective against hair worms was found to give little measure of control when used as a drench on sheep. Analysis showed the compound to contain 79.7 per cent. phenothiazine associated with a small quantity of inorganic material but the melting point on recrystallisation lay outside the recorded figure for the pure drug.

To engage in an active programme of aerial baiting for wild dogs and dingoes, the Department of Agriculture called tenders for baits of brisket fat each completely enclosing ½ grain strychnine tablets.

Analysis of 12 samples supplied showed them to be of a friable nature consisting of a finely ground meal, largely vegetable, with a total fatty content averaging 13.7 per cent. of the whole weight of the bait. Strychnine in crystal form was visible on the outer surfaces and varied in amount from 0.08 to 0.28 grains.

Investigations carried out by the Department of Agriculture on the use of superphosphate in drinking water as a cheap source of phosphate to correct known phosphorus deficiency in dairy herds in the South-West raised the question of toxic fluorine ingestion.

Solutions which were prepared from commercial superphosphate at various concentrations and dilutions showed considerable variation in fluorine content. Urine and faeces of sheep receiving superphosphate, rock phosphate, etc., was also examined for phosphate content and excretion of fluorine. In all, 60 samples were analysed and the conclusion may be drawn that there is no evidence that the use of superphosphate or rock phosphate in recommended concentrations has raised the fluorine intake of stock to toxic concentrations.

Industrial Toxicology.

Lead Hazard in Industry.

A total of 42 samples of urine were examined as routine checks on workers exposed to lead hazards in the W.A.G.R., patients of the Repatriation Department, Royal Perth Hospital, or medical practitioners to support diagnosis of suspected chronic poisoning.

A claim for compensation was made by a worker employed for various periods caulking water pipes with lead. Specimens of sludge said to cover the hands during this operation were found to consist of minute fragments of metallic lead, oxide and carbonate, and ferruginous soil. Personal cleanliness rather than an industrial hazard seemed implicated, particularly as there was some record of drinking the water leaking from the joints.

Industrial Hygiene.

An investigation was made by the Public Health Department into the hazard of wheat dust whilst bulk loading a ship at Fremantle. Samples of the dust lying between deck were submitted for analysis. Large fragments of extraneous material were rejected and the determinations were made on material passing a 40 mesh sieve as representing possible airborne material. This consisted of wheat hairs, epicarp and other bran tissue of wheat grain and fine grains of mineral matter. Total silica in this material matter represented 3.56 per cent. of the total presumed airborne dust. It was not possible to determine how much of this was free silica but would undoubtedly represent a small fraction. Readings taken *in situ* by a Watson konimeter were subsequently checked by microphotographs and are commented upon in the report of the Deputy Government Mineralogist.

A proprietary dressing for iron surfaces preparatory to painting, containing approximately 36 per cent. free phosphoric acid, was examined and a report issued on the hazards attending its use and safe handling.

Eight samples of air taken from time to time in various localities of the Collie coalmines failed to show any significant vitiation of the atmosphere.

A hat band thought to be responsible for acute dermatitis after examination by the Medical Laboratories was submitted for analysis for dyes and irritant chemical substances frequently associated with dermatitis. None of these substances were found but the band was chrome tanned and chrome sensitivity was consequently suggested as a possible cause of the dermatitis.

Insecticides.

Attention was drawn in last year's report to the pressing need for a control administration cognisant with the toxicity of the ever expanding list of complex organic insecticides and advising on and controlling the distribution, safe use and hazards to horticulturists and the general public. Action along these lines was referred to State authorities by the National Health and Medical Research Council and a strong Committee representing Health, Agricultural, Pharmaceutical and Analytical interests has been formed to advise the Government through respective ministers on action to provide safeguards for persons formulating, handling or using new organic pesticides and weedicides.

Four samples of bran baits for grasshopper control containing gammexane were examined as the result of complaints of poor results in certain country districts. The baits varied from 0.06% to 0.45% of benzene hexachloride indicating inadequate mixing, either of the baits or in the original insecticide mixture reputed to contain 10% benzene hexachloride in an inert carrier. A further investigation showed in 16 samples of the original insecticide supplied variations in benzene hexachloride from 6.7% to 20.9%.

Samples of sodium fluosilicate were again examined as the result of some doubts as to their effectiveness as the poisonous principle in fruit fly baits. Analysis did not disclose any material difference in composition or physical state of various supplies which affect their efficiency as the poisonous principle.

To check the unit concentration and distribution of insecticides discharged inside buildings by a T.I.F.A. fog machine, the Department of Public Health submitted six glass plates exposed at varying heights and positions throughout a building sprayed with D.D.T. In the initial test of 5% solution of D.D.T. in kerosene was used, which, probably as the result of the high temperature involved, showed only 2.6% in the condensate at the distributor head. The concentration of D.D.T. on the plates was considerably below the limits of analytical accuracy.

Nine samples of fly sprays for general indoor use and also sprays for residual action submitted for Government tender were analysed to see whether they complied with relevant specifications. In one indoor spray the D.D.T. was over 10 times the requirement, whilst in another—a proprietary line, the components bore little resemblance to the specification.

Miscellaneous work on insecticides included the examination of soils, previously treated with D.D.T. for mite control, for residual D.D.T. after two years, analyses of D.D.T. concentrates and sprays, Argentine ant baits, lime sulphur spray, spray damaged peaches and leaves and a mercury turf fungicide.

Swan River Pollution.

The collection of samples for chemical and bacteriological examination in the survey of Swan River pollution referred to in previous reports has been continued throughout the year making a total of 288 samples.

Throughout the year many trade wastes have been diverted from storm water drains (which flow into the river) to the sewers, but generally the wastes diverted have been from small factories, and the effect on pollution is slight. Diversion of the wastes, which constitute the major sources of pollution, will be carried out as soon as materials and labour are available, and when this is done the condition of the polluted sections of the river should materially improve.

Representations were made to extend the survey to include Fremantle Harbour, and one series of tests was conducted at 12 selected points ranging from Rocky Bay to the Harbour entrance, the latter sample serving as a reference sample. On the particular day of the Survey, every Harbour berth was occupied, some liners of large tonnages being berthed, and one vessel was also moored to a river buoy. A strong north-west wind was blowing and the tide set up-stream, all creating conditions favourable to maximum conditions of river pollution. Generally, however, this series of tests showed that the pollution effect from the Harbour does not extend far up stream.

Mud samples from the bed of the river in the upper reaches and from points at popular beaches and adjacent to public baths, were collected for observation and chemical and bacterial examination. All samples consisted predominantly of sand and shell, but showed varying amounts of organic matter consisting of both living and dead marine growth, and black silt. The bacteriological report showed organisms common to such samples. The means of carrying out a botanical and biological investigation of river flora, which was stated in last year's report to be an early need, was further exploited during the year. A report on this aspect has been prepared at the instance of the Government Botanist giving an appreciation of the present situation, causative factors and outlining possible remedial measures.

Chemical Sewage Control.

Routine.

The number of samples under this heading continues to increase, a total of 2,308 being examined in the weekly inspection of the two main treatment plants.

Construction of two extra digesters at Subiaco, which was commenced during the year, will still further increase the chemical control work when in operation.

Ten complete analyses were also made of the sewage from the plants at six monthly periods. These analyses support and supplement the more frequent routine tests and indicate that the plants are working satisfactorily.

Investigational.

Investigations into the hydrogen sulphide problem and corrosion of concrete sewers was continued. Three thousand, three hundred and ninety-seven samples in all were examined under the various aspects of the problem, and much useful information has been obtained applicable to our Metropolitan sewerage system but which may also serve as a contribution to the work being done throughout Australia.

In November, Mr. E. C. Hodgson, Analyst and Research Officer, of this Division, attended a conference convened by the Melbourne and Metropolitan Board of Works, to consider co-operative action by the Authorities throughout Australia concerned in the hydrogen sulphide problem in sewage. Mr. Hodgson spent some time in Melbourne working in the laboratory of the Melbourne and Metropolitan Board of Works studying methods and techniques in order that results obtained in Melbourne and Perth will be comparable.

A programme of investigational work along the lines of that being carried out in Melbourne, but with particular reference to local conditions, has been arranged.

It will be seen from the number of samples examined that the amount of work being done for the Metropolitan Water Supply, Sewerage and Drainage Department is increasing considerably and extra staff will be necessary to cope with the future programme.

Ocean Outfall and Beach Surveys.

The usual four beach surveys and one ocean outfall survey were carried out in 1950 during which 170 samples were taken for chemical and bacteriological examination in collaboration with the Medical Laboratories.

No gross pollution of the beaches by sewage effluent was shown by these surrveys.

Trade Wastes.

Twenty-two samples of trade wastes were examined partly in continuation of the policy of diverting trade wastes from storm water drains to sewers and partly to check whether wastes discharging or projected, comply with departmental regulations.

The special claims of a material for sanitary disposal were rejected after investigation as being inimitable to existing regulations and safe manipulation.

Aeronautical Inspection Directorate.

Work for this departmental consisting mainly in identifying oils and chemicals which had lost their original designation.

Turpentine and a hydraulic fluid found to consist of approximately equal volumes of castor oil and normal butyl alchol, were given full examinations under their relevant specifications.

Miscellaneous Samples.

A number of miscellaneous samples difficult of classification under the general activities of the Division were received during the year. These cover a wide range of products and frequently require specialised knowledge and the use of specialised equipment calling for a detailed report rather than a certificate of analysis.

These included:—The determination of the components of a linoleum underlay which had proved unsatisfactory in hospital construction; the determination of flash point of acetic acid grades manufactured by the State Wood Distillation and Charcoal Iron Industry, analyses of explosives and fireworks required before authorisation; lubricating and fuel oils for general analyses and for compliance with specification; reputed oil shales and petroleum finds; paints; latex used for pipe sealing; crude wool grease as a possible product for export; identification of fungicide treated wheat, supposed ambergris and a number of identifications of unknown materials found in pipes, engines, etc.

AGRICULTURAL, FORESTRY AND WATER SUPPLY DIVISION.

Annual Report for the Year Ended 31st December, 1950.

By L. W. Samuel, Ph.D. (Lond.) F.A.C.I., A.R.I.C.

Deputy Government Agricultural Chemist.

Soils.

A total of 469 samples of soil were examined during the year.

(a) The work on the high pH soils from the Carnarvon area referred to in my reports for 1948 and 1949 has been continued. To reduce the soil pH the Department of Agriculture is conducting an experiment using dressings of sulphur and of gypsum, separately and together, at two different rates of application. The 21 plots were sampled before treatment, at approximately monthly intervals for six months after treatment and again at 12 months after treatment. In all, 168 samples of soil from this experiment have been examined for pH value and 63 of these for exchangeable cations.

Before treatment the pH values of the 21 plots ranged from 8.3 to 8.9 Dressings of gypsum did not markedly affect the soil pH but dressings of sulphur, whether applied with or without gypsum, markedly reduced the pH value.

The application of 500 lb. per acre of sulphur reduced the average pH value of three plots to 7.6 in five months. Applied with 500 lb. of gypsum the average pH was reduced to 6.9 in four months. A dressing of 1,000 lb. per acre of sulphur alone reduced the average pH value to 6.1 in five months, and applied with 1,000 lb. per acre of gypsum, reduced the average pH value to 6.3 in five months.

A further 66 samples of soil from the Carnarvon district were examined, including eight saline soil crusts from banks of the irrigation areas. The pH values of these eight soil crusts ranged from 8.0 to 10.5 and the total water soluble salts from 0.73 per cent. to 2.63 per cent. The water extracts of these soil crusts were analysed for calcium, magnesium, sodium, potassium, bicarbonate, carbonate, sulphate and chloride.

(b) Because of the relatively high chlorine content of tobacco leaf grown in Western Australia the soils of the Tobacco Research Station at Manjimup were sampled according to soil type and analysed for water soluble chloride ion, and the pH determined. A total of 173 samples was obtained from 48 sites in December, 1949. A soil survey of the Research Station by officers of the Department of Agriculture recognised and mapped eight soil types and in the present soil examination the samples at each site were taken according to the soil profile. Table I shows the average values of water soluble chloride and of pH for each soil type and for brevity the profile sampling depths have been represented as 0-12in., 12-24in. and 24-36ins. respectively.

In general there is a decrease in water soluble chloride with increasing depth to three feet but the pH profile is relatively uniform, all values being slightly acid.

Comparison of the soil chloride values from individual sites with the few previous analyses for chloride of tobacco leaf from the same areas on the Station did not support the theory that high leaf chloride was due to high soil chloride, for leaf of high chloride content came from sites of low soil chloride.

A further series of eight samples from three soil types at Karridale and 17 soil samples from five plots at Northcliffe were analysed for pH and for water soluble chloride as exploratory plots of tobacco have been grown at these centres.

TABLE I.

Tobacco Reasearch Station, Manjimup.

Soil Analyses.

Soil type	1	2	3	4	5	6	7	8
Number of sites sampled	12	7	2	2	14	3	4	3
Depth, inches*	Chloride ion Per cent. of dry soil Average.							
0–12	0·003	0·003	0·005	0·004	0·008	0·008	0·015	0·004
12–24	0·002	0·001	0·002	0·003	0·005	0·007	0·005	0·003
24–36	0·001	0·001	0·001	0·001	0·004	0·003	0·002	0·004
	Average pH value.							
0–12	6·0	5·5	6·6	6·0	6·0	6·0	6·1	5·8
12–24	6·1	5·7	6·6	6·3	6·0	6·0	6·1	5·7
24–36	6·1	5·8	6·6	6·2	5·8	5·8	5·8	5·7

* The samples were taken at different depths according to the soil profile but for brevity they are represented as 0–12 in., 12–24 in., 24–36 in. to cover the sampling range of eight different soil types.

(c) Consequent upon enquiry from the Department of Agriculture re the determination of soil boron soluble in hot water attention was re-directed to the methods of estimating small amounts of boron. To date the determination of boron in plant materials in these Laboratories had been by the quinalizarin colour reaction, but comparison of this method with the more recent method using carmine showed this latter method to be superior in obedience to Beers Law, in insensitivity to variations in concentration of the concentrated sulphuric acid solution used, and in range of concentrations of boron measureable.

A study of the literature disclosed variations in the method of extracting hot water soluble boron from soils; two variants being Berger and Truog refluxing 20 g. soil with 40 ml. water for five mins. and Rogers shaking 15 g. soil with 75 ml. water for one hour and then refluxing for 30 mins. A study by Haas showed marked variations of the quantities of boron extracted from the same soil by variations in the method of extraction.

As a preliminary, two soils were examined, a clay loam from the Merredin Agricultural Research Station and a loamy sand from the Tobacco Research Station, Manjimup. Various methods of extraction were tried and the results are shown in Table II.

TABLE II.

Soil Boron (B) Soluble in Hot Water.

Method of Extraction. Time of: Shaking.	Standing.	Reflux.	Soil : Water Ratio.	Clay loam, Merredin.	Loamy sand, Manjimup. 0–12 in.	12–24 ins.
				Parts per Million.		
Nil	*Nil*	5 min.	1 : 2	1·11	....	....
Nil	*Nil*	30 min.	1 : 2	1·42	0·62	0·58
1 hr.	*Nil*	30 min.	1 : 5	1·52	....	....
1 hr.	*Nil*	30 min.	1 : 2	....	0·60	0·62
1 hr.	*Nil*	60 min.	1 : 2	1·81	0·62	0·64
1 hr.	Overnight	60 min.	1 : 2	2·00	0·66	0·64

These results indicated that for a soil containing an appreciable amount of clay a relatively severe extraction method was necessary to obtain maximum amounts of boron but for a soil low in clay practically complete extraction of boron was obtained with 30 min. refluxing of the soil water suspension.

Four very sandy soils submitted by the Department of Agriculture were examined using various extraction methods with the results shown in Table III.

TABLE III.
Soil Boron (B) Soluble in Hot Water.

Sample :				1	2	3	4
Lab. No.				6755	6756	6757	6758
				Parts per Million on dry basis.			
Method of Extration. Shake.	Stand.	Reflux.	Soil : Water Ratio.				
Nil	*Nil*	5 min.	1 : 2	0·40	0·38	0·42	0·36
Nil	*Nil*	30 min.	1 : 2	0·44	0·44	0·50	0·44
Nil	*Nil*	60 min.	1 : 2	0·44	0·44	0·50	0·44
60 min.	*Nil*	5 min.	1 : 2	0·44	0·42	0·36	0·40
60 min.	*Nil*	30 min.	1 : 2	0·44	0·40	0·50	0·40
60 min.	*Nil*	60 min.	1 : 2	0·44	0·44	0·56	0·44
60 min.	Over-night	5 min.	1 : 2	0·44	0·44	0·36	0·36
60 min.	Over-night	30 min.	1 : 2	0·44	0·42	0·50	0·44
60 min.	Over-night	60 min.	1 : 2	0·48	0·42	0·50	0·48

(d) The Department of Agriculture conducted a study of the inheritance of nitrogen in wheat using 18 varieties of wheat grown at three Agricultural Research Stations, with three times of planting, three levels of application of nitrogen fertiliser and four replications. There were 648 samples of soil available from these experimental plots and as a preliminary investigation 30 soil samples, being samples from three different varieties at three Stations at three levels of nitrogen fertiliser application were analysed for total nitrogen. There was no material difference in the total nitrogen of the soil at different rates of nitrogen fertiliser at each Station, but soil from the Merredin Agricultural Research Station had some two to three times as much total nitrogen as did samples from the Avondale or Wongan Hills Agricultural Research Stations.

Waters.

The total of 1,632 samples of water examined for the year is an increase of more than 25 per cent. over the 1,241 samples received in 1949.

By far the greater number of the samples examined were for suitability for domestic, stock and irrigation purposes, received not only direct from farmers, graziers and market gardeners, etc., but also from the War Service Land Settlement Scheme, the Department of Agriculture and the Inter-Departmental Irrigation Water Committee.

(a) The routine examination of existing water supplies to towns and cities has been continued and involved the examination of:—

Twenty-eight samples from the Canning Dam, Churchman's Brook, Victoria Reservoir, Wungong pipe-head dam and Mt. Eliza Reservoir, supplying the Metropolitan Area.

Thirty-one samples from Mundaring Weir, Mt. Charlotte Reservoir and the Kalgoorlie reticulation for the Goldfields Water Supply. These included monthly samples from Mundaring Weir but no daily samples from the overflow were received as the weir did not fill in 1950.

Ten samples from the Wellington Dam, a source of water for the comprehensive water scheme for the Agricultural areas.

Eight samples from the Onslow water supply.

(b) A total of 66 samples were examined of either present supplies or prospective supplies to country centres throughout the State. Particular attention was given to further sources of supply for the Geraldton area because of the requirements for irrigation by tomato growers.

(c) The determination of the amount of silt carried by the Ord River was continued and nine samples were examined in connection with the proposed Ord River Dam and irrigation project. The water from these samples is also examined chemically, as were periodic samples from the Ord River forwarded by the Department of Agriculture. All samples examined from the Ord River have been suitable for all domestic, stock and irrigation purposes.

(d) A series of samplings of the Avon River at Beverley, Northam, and York were examined.

(e) The systematic sampling of the rivers and streams in the South-West ceased in 1948, but samples were obtained in 1950 from 24 of these rivers and streams and were examined for comparison with previous results.

(f) Two series of samples were examined for the Inter-Departmental Committee for Standards for Irrigation Waters. One series was from the Canning River on which much work had been done previously and the other series was from a well nearby for which there was available considerable information re its use for irrigation.

During 1950, the publication "Waters for Agricultural Purposes in Western Australia" was revised and expanded and published in the Journal of the Department of Agriculture of Western Australia, Vol. XXVII (Second Series) No. 2, June, 1950, pp. 156-60. A reprint of this article in leaflet form is enclosed with each report on a water analysed for domestic, irrigation and stock purposes.

(g) The Department of Agriculture is experimenting with the addition of water soluble copper and cobalt compounds to the drinking water for stock on one of the sheep stations in the north of the State, with the object of correcting a deficiency in these elements. At some of the watering points on this Station the copper is precipitated from the water. An examination was made of 138 samples of water from this Station to ascertain the reason for, and extent of, this precipitation but the analyses did not offer any explanation for the precipitation.

(h) Of the miscellaneous samples of water tested, interest attaches to one from a soda spring in the north of the State for which the bicarbonate ion exceeded the sum of the calcium and magnesium ions. This spring was highly commended for washing purposes.

Fertilisers.

(a) Analyses were made of 35 samples of fertilisers under the Fertilisers Act, 1928 and only 18 complied with the registered analysis, the causes of non-compliance of the other 17 samples being shown in Table 4.

TABLE 4.

FERTILISERS ACT, 1928.

Analysis of Samples during 1950.

Constituent.	No: Total Analysed.	Deficient.	Complied.
Nitrogen (N)	28	4	24
Water soluble potash (K_2O)	14	5	9
Phosphoric acid (P_2O_5)—			
Water soluble	25	5	20
Citrate soluble	25	0	25
Acid soluble	25	1	24
Total	31	4	27
Copper (Cu)	1	1	0
Fine material—			
(a)	1	1	0
(b)	1	1	0

(b) Samples (six) of lupin crops to be ploughed in as green manure for an orchard were analysed for nitrogen, phosphorus, potassium, copper, manganese and zinc to ascertain the quantity of these fertiliser elements contributed by the green manure. The lupins had received different fertiliser treatments involving superphosphate, potash, zinc and copper. There were no marked differences in the nitrogen, phosphorus or copper content of the lupin plants but there was considerable variation in the potash, manganese and zinc contents.

(c) Miscellaneous samples analysed included:—

(i) Several samples for zinc and for copper in the search for sources of these trace elements as fertilisers.

(ii) A sample of superphosphate which had been heated in a boiling water bath for half an hour on each of three successive days. This sterilisation treatment had not materially affected the proportions of water soluble, citrate soluble and acid soluble phosphate as compared with the untreated superphosphate.

(iii) Two samples of superphosphate made from rock from Ocean Island and Christmas Island respectively gave the following results, Table 5.

TABLE 5.

Sample	Ocean Island. Superphosphate 1950	Christmas Island. Superphosphate. 1950
Lab. No.	6882/50	6883/50
	Dry Basis. Parts per Million.	
Copper, Cu	38	65
Manganese, Mn	38	64
Molybdenum, Mo	0·4	0·2
Zinc, Zn	625	424

(iv) Two samples of cave guano which had respectively 4.7 and 10.9 per cent. of total phosphoric acid (P_2O_5) and 0.26 and 2.4 per cent. of nitrogen, (N).

(v) Nine samples of "lime" which were examined for neutralising value for use on acid soils.

(vi) Three samples of kangaroo carcase with a view to possible use as an animal fertiliser.

Pastures and Feeding Stuffs.

(a) In continuation of the investigation of the composition of pasture under differing rates and times of application of superphosphate to irrigated and non-irrigated land in the south-west dairy areas 124 samples of pasture cuts were examined for dry weight, calcium, nitrogen, phosphorus and potassium.

These analyses confirmed that variations in the relative abundance of different pasture plants caused greater variation in the chemical composition of the sward than did variations in fertiliser treatment per se.

Analyses have also been made of five pasture samples, being the third annual cut from an experiment in which different proportions of lime are mixed with the superphosphate before application. There has been no marked effect of fertiliser treatment on the chemical composition of the pasture cut, but for all rates of lime (including no lime) and also when superphosphate and lime were applied separately, there has been a decrease in the calcium and in the nitrogen content of the pasture during the three years that the experiment has been conducted. There has not been a similar change in the phosphorus and potassium contents.

A further 11 samples of pasture were analysed for five major and for four trace elements, being the first cuts from two further fertiliser experiments involving the application of lime.

(b) A series of 26 samples of subterranean clover were analysed for nitrogen, being samples from an experiment on the establishment of subterranean clover on light land in the wheat belt. There were 13 treatments and two sub-treatments. Many of the samples were heavily contaminated with soil and an approximate correction for this was obtained from the insoluble residue in the Kjeldahl digestion. There were relatively small differences (of the order of 10 per cent.) in the nitrogen content of the samples from different treatments but there were very large differences in yields.

In the Annual Report for 1947, reference was made to contamination with soil of pastures with a low or trailing habit of growth. An outstanding example of this soil contamination was encountered in 1950 in these 26 samples of mature subterranean clover plants to be analysed for nitrogen. Since this plant buries its seed, a burr, under the soil, soil contamination of the harvested plant was large. The plants had been grown in a very light, sandy soil and the harvested weight of different treatments varied from seven grams to 465 grams (oven dry). By teasing and shaking the samples over a sieve much soil was removed, the amount removed varying from 0.6 g. to 140.7 g. For the small samples there was no relationship between the crude harvest weight and the amount of soil removed, but for samples in excess of 100 g. there was a relatively constant relation, the quantity of soil removed varying from 23.4 per cent. to 30.2 per cent. of the original harvest weight, except for one sample, 39.5 per cent. The average weight of soil removed was 28 per cent. of the harvest weight.

Not all of the soil was removed by this method and an attempt to measure the residual contamination was made by using a 5 g. sample for the Kjeldahl nitrogen digestion and weighing the residual silica. This is not an accurate measure of soil contamination, but is a minimum value. The method is more applicable to the very sandy surface soil involved in this instance than to soils containing much clay. The residual contamination was large, varying from 6.7 per cent. to 39.4 per cent. of the weight of the sample after sieving. Although there was a relationship between the residual contamination and the weight of the sieved sample (for samples of more than 100 g. weight) this relationship was not as good as the previous one for the soil sieved out. For samples of over 100 g. the range of residual contamination was from 14.5 per cent. to 31.7 per cent. of the sieved sample with a weighted average of 22 per cent.

The minimum total soil contamination therefore varied from 9.6 per cent. to 49.6 per cent. of the original sample. For samples of over 100 g. the range was 37.4 per cent. to 49.6 per cent. with a weighted average of 43.8 per cent. with a good correlation between original sample weight and soil contamination.

(c) Pasture species from the Kimberley Division of the State have been analysed for the usual proximate feeding stuffs analyses and calcium and phosphorus. Most of the samples were grown at the Kimberley Research Station and included several samples of the same species some with or without superphosphate, some with and without irrigation and some at various stages of growth.

The following pasture plants were analysed:—

Andropogon gayanus.
Elephant grass (Pennisetum purpureum).
Flinders grass (Iseilma fragile).
Guinea grass (Panicum maximum).
Molasses grass (Melinis minutiflora) .
Native couch (Brachyachne convergens).
Para grass (Brachiara mutica).
Paspalum scrobiculatum.
Rhodes grass (Chloris Gayana).
Stylosanthes gracilis.

(d) Pastures and fodders from the wheat belt included—

(i) for nitrogen, 70 samples of pasture from a rotation and grazing experiment at the Wongan Hills Agricultural Research Station being, annual (volunteer) grass, oats and annual grasses, lupins and annual grasses, oats and Brome grass, capeweed, subterranean clover and capeweed, peas and capeweed, lupins and capeweed, lupins (including stem, leaf, petiole, pod and seed separately), oats, peas and oats, oat grain, peas (also grain separately), subterranean clover, oats and Wimmera Rye grass, lupins and Wimmera Rye grass, subterranean clover burr. The range in nitrogen content, per cent. on dry basis, was from 0.23 for an oat sample to 5.14 for a sample of lupin and lupin seed.

(ii) cereal grazing and recovery trial at the Merredin Agricultural Research Station. Cuts were made in July and August of five oat varieties and two barley varieties and analysed for calcium, phosphorus and the usual feeding stuffs components. There was little difference in composition between the seven cereals in either the July or August cut except that the two barley varieties and the Guyra oats had more calcium than the other four oat varieties.

Comparing the July and August cuts the August cut had less protein and less calcium than the July cut.

(iii) six samples of pasture from a cultivation and fertiliser experiment at the Wongan Hills Agricultural Research Station were analysed for phosphorus. There was no material difference in the phosphorus content of the pasture whether superphosphate was applied or not, or whether the superphosphate was applied with a combine, or a disc drill or was broadcast.

(e) A number of other fodders were analysed for calcium, phosphorus and the usual feeding stuffs constituents. These included mixed pasture (ten samples), white seeded subterranean clover (three samples), vetch (five samples), lucerne (one sample), meadow hay (three samples), cereal hay (15 samples), oat grain (one sample), oat chaff (two samples), tree lucerne (eight samples), and whalemeal (one sample).

(f) The Feeding Stuffs Act, 1928-1948 requires the registration of—

Minimum crude protein content.

Minimum crude fat content for a feed not of animal origin.

Maximum crude fat content for a feed of animal origin.

Maximum crude fibre content.

In addition, the manufacturer or agent may register the content of any other substance of reputed nutritional value.

Except for bran and pollard (no samples of which were analysed in 1950) and for some poultry mashes, there are no "Government" standards to which a feed must conform, but any feed sold should conform to the registered composition. My reports for 1948 and for 1949 noted the practical impossibility of a commercial feed complying with a registered analysis to the second decimal place for e.g. calcium, phosphorus, sodium chloride, and recommended such registrations should be for a maximum or minimum or for both. This recommendation has been partially implemented and some, but not all, registrations show a maximum or minimum or both for all registered analyses.

A further anomaly referred to in my 1949 report has not been corrected. The anomaly is that although the Fertilisers Act, 1928, prescribes the fineness of grinding of some fertilisers there is no similar provision in the Feeding Stuffs Act except for pollard. From some samples received it is highly desirable that fineness be prescribed for some feeds, particularly those containing bone and especially those described as bonemeal or boneflour.

Of the 150 samples of feeding suffs analysed during 1950, for compliance with the Act, only 89 complied with the legally required registration of crude protein, crude fat and crude fibre. Only 42 samples complied with all of the components registered by the manufacturer or agent and the causes of non-compliance are shown in Table 6.

TABLE 6.

FEEDING STUFFS ACT, 1928-1948.

Analysis of Samples during 1950.

Constituent.	No: Total Analysed.	Deficient.	Complied.	Excess.
Crude protein (N x 6·25)	150	14	136	....
Crude fat (petroleum ether extract)	141	30	107	4
Crude fibre	141	....	101	40
Sodium chloride	109	5	67	37
Phosphoric acid (P_2O_5)	25	4	4	17
Calcium (Ca)	125	20	76	29
Copper (Cu)	1	....	....	1
Sulphur (S)	1	1	....	....

Only one sample of stock lick was analysed in 1950 and this complied with the registration for phosphoric acid and for lime, but had an excess of common salt.

Plant Nutrition.

The analyses of plant material for the Plant Nutrition Branch of the Department of Agriculture are for (a) diagnosis of unhealthy plants (b) variation in composition as a result of various fertiliser applications, (c) investigation of the zone of absorption by roots, (d) comparison of various compounds as a source of the required fertiliser element, (e) comparison of methods of application of fertilisers, (f) testing the effectiveness of various fertiliser treatments in correcting unthriftiness of plants.

Apple Leaves.

Samples of leaves taken in December, 1949 and in March, 1950, from six trees to which manganese fertiliser had been applied at different depths in August, 1946, were analysed for manganese. Leaves from trees which had received manganese fertiliser did not consistently show higher manganese content than the controls but the direct comparison of treated and untreated trees was similar for the December and for the August samplings.

A series of nine leaf samples taken in March, 1950, from trees to which manganese fertiliser had been applied at different depths in September, 1947, showed greater leaf manganese where the fertiliser had been applied more than a foot below the surface of the soil than where the application had been in the top 6in. of soil.

When sampled in March, 1950, there was no marked difference in the manganese content of leaves from trees to which 1 lb. and 2 lb. of manganese sulphate had been applied in August, 1948, but there was an increase in manganese content where 4lb. manganese sulphate had been applied.

For nine samples taken in late December, 1949, and early March, 1950, there was no difference in magnesium content of leaves of trees which had received magnesium sulphate or magnesium carbonate late in 1947.

No marked difference in potassium or phosphorus content of the leaves was shown for samples taken in March, 1950, from trees which had received separate applications of potassium and phosphatic fertiliser in September, 1947.

Barley Plants.

The use of a zinc fertiliser with superphosphate did not cause any change in the copper, manganese, zinc, calcium, magnesium, nitrogen, phosphorus, or potassium contents of barley plants compared with the use of superphosphate alone.

Samples (six) from a trace element fertiliser experiment were analysed in connection with the establishment of agriculture on the light land near Esperance. The use of double rates of superphosphate, or the use of copper and zinc fertiliser did not materially affect the plant composition with respect to molybdenum, calcium, magnesium or nitrogen. The use of a zinc fertiliser appeared to reduce the copper content of the plant and this reduction was not completely nullified by the use of a zinc and copper fertiliser. The manganese content was reduced by the use of a zinc fertiliser and reduced still further by the use of a zinc and copper fertiliser. The zinc content was increased by the zinc fertiliser but the increase was less when a copper fertiliser was applied with the zinc.

Where superphosphate was applied at the rate of 1 cwt. per acre the phosphorus content of the plant was reduced by the use of a zinc fertiliser and was reduced still further by the use of a zinc and copper fertiliser. These reductions however, did not occur when superphosphate was applied at the rate of 2 cwt. per acre.

The potassium content of the plant was reduced by the use of a zinc fertiliser and was reduced still further by the use of a zinc and copper fertiliser. These reductions occurred whether 1 cwt. or 2 cwt. of superphosphate per acre was applied.

Applications of 2 cwt. of superphosphate per acre with or without zinc and/or copper increased the phosphorus content of the plant compared with the use of 1 cwt. of superphosphate per acre.

Cabbage Leaves.

Two samples of cabbage leaves were analysed, one showing marginal scorch and chlorosis had more nitrogen and less potassium than one showing slight chlorosis with deep purpling commencing from the margins and slight veinal purpling. There was no material difference in the phosphorus content of the two samples.

Cauliflower Leaves.

Two samples of cauliflower leaves were analysed, one showing chlorosis and yellow marginal scorch had less nitrogen, phosphorus and potassium than the other from bigger and better plants, though this latter sample showed purple marginal scorching running back deeply into the main body of the leaf.

Clover Plants.

The majority of the 81 samples of subterranean clover analysed during 1950 were from fertiliser experiments.

(a) One such experiment to compare sodium molybdate and molybdenum trioxide as sources of molybdenum at different levels of application showed that the use of a molybdenum fertiliser did not affect the calcium, magnesium, phosphorus or potassium content of the plant, but did increase the molybdenum content, the increase being greater the greater the rate of application of the molybdenum fertiliser. Sodium molybdate and molybdenum trioxide were equally effective in raising the molybdenum content of the plant.

(b) Samples (20) at approximately monthly intervals from June to October were received from a fertiliser experiment on mid-season subterranean clover which received a basal dressing of a superphosphate and copper fertiliser and different plots received 0, 25, 50 and 100 lb. of potassium chloride per acre respectively. The differing rates of potassium chloride did not affect the calcium, magnesium, or phosphorus content of the plant at any stage of growth. For the June sampling, increasing rates of potassium chloride reduced the molybdenum content but later samplings showed no effect of rate of application of potassium chloride on molybdenum content.

As growth proceeded the calcium content remained practically constant for June, July and August, increased in September and further increased markedly in October; the magnesium remained practically constant from June to September and increased appreciably in October; the phosphorus content remained constant from June to August, decreased in September, and further decreased slightly in October; the potassium content was relatively constant for June to August for each rate of application, but decreased markedly in September with a further marked decrease in October, the decreases in both September and October being greater the larger the application of potassium chloride fertiliser.

The potassium content of the plant in June increased steadily from the nil to the 50lb. per acre plot and increased markedly for the 100lb. per acre plot. For the July and August samples the potassium content was relatively constant for the 0, 25 and 50lb. per acre plots, but there was again a marked increase for the 100lb. per acre plot. The September sampling was similar to the June sampling (though at a much lower level of potassium) showing a steady increase in potassium content from the 0 to 25 to 50lb. per acre plot and a marked increase for the 100lb. per acre plot. However, by the October sampling the great rate of decrease of potassium with increasing plant growth resulted in the plants from 25, 50 and 100lb. per acre plots being practically equal in potassium content and less than those from the nil plot.

(c) Samples (four) from a zinc fertiliser experiment showed no marked difference in potassium, copper or molybdenum between samples from the superphosphate only and the superphosphate plus zinc fertiliser plots but the zinc fertilised plants had some nine to ten times as much zinc as did those from the no zinc plots.

(d) A rate of superphosphate and zinc oxide fertiliser experiment was sampled in July and in September and the 24 samples analysed. Neither sampling showed any appreciable effect of fertiliser treatment on the calcium, magnesium, phosphorus, potassium, copper, manganese or molybdenum content of the plants except a slight increase in the phosphorus content of the September samples with increase in the rate of application of superphosphate. For both samplings there was a definite increase in the zinc content of the plants with increasing rate of application of zinc oxide. Comparing the September sampling with the July sampling there was no marked change in magnesium, phosphorus, potassium, manganese, molybdenum or zinc content of the plants but there was an increase in calcium and a decrease in copper content.

(e) (i) Two samples, one of green clover and the other of affected yellow-leafed clover, showed no difference in manganese, phosphorus or nitrate content, but were another example of heavy soil contamination of this plant, as has been previously noted. Nearly 10 per cent. of soil was sieved from one of these samples.

(ii) Two samples from a pot experiment, one of unhealthy clover grown on "new" light land and the other of healthy clover grown on "old" light land, showed no difference in total sulphur content but the unhealthy clover had less than half the phosphorus content of the healthy clover.

(iii) Of four samples of clover which were healthy and unhealthy plants from potash and no potash fertiliser plots the two samples of healthy clover had considerably more potassium than had the unhealthy plants.

(iv) Analysis of another four samples of clover, being two unhealthy and two healthy, suggested that zinc deficiency was the cause of the unhealthiness. This was also the probable cause of unhealthiness in two of five samples analysed for nitrogen, phosphorus, copper and zinc. These samples were from a fertiliser experiment for the establishment of pastures on the light land near Esperance. These samples also showed very heavy soil contamination, nearly one-third of the sample as received consisted of soil.

(v) Although zinc deficiency was the cause of unhealthiness in these two groups of samples it was not the cause of yellowing and striping of the leaves of subterranean clover samples from the Denmark Research Station.

(f) Four samples of subterranean clover seed were analysed and showed little difference in the content of calcium, magnesium, nitrogen, phosphorus, potassium, sodium or sulphur. There were considerable differences however, in the copper, manganese, molybdenum and zinc contents.

Lupins.

In addition to the six samples of lupin plants analysed as green manure, 16 samples of New Zealand Blue Lupins were analysed for calcium, magnesium, nitrogen, phosphorus, potassium, boron, copper, manganese, molybdenum and zinc. These were July and August cuts from a fertiliser experiment involving superphosphate, potash, copper, boron, zinc, molybdenum and manganese.

There was no marked effect of fertiliser treatment on calcium, nitrogen and phosphorus content, and samples from the August cut had lower calcium, nitrogen and phosphorus values than the corresponding values from the July cut. For magnesium and potassium contents there was no marked effect of fertiliser treatment, and samples from the July and August cuts had very similar values. The boron content was variable, being high in the July cut from the boron fertilised plot and high in the August cut from the manganese fertilised plot. The copper content was unaffected by fertiliser treatment or by time of cutting. The manganese content was very variable and was much lower in the August cut than in the July cut. The molybdenum content was high in plots fertilised with molybdenum and manganese separately and

the August cut had less than the July cut. The zinc content was variable and the August cut showed lower values than the July cut, except for the manganese fertilised plot.

Mandarin Leaves.

Three samples of mandarin leaves were examined for calcium, magnesium, phosphorus, potassium, boron, copper, manganese, molybdenum and zinc. These were (a) very chlorotic leaves, (b) normal green leaves from the same tree, and (c) comparatively green and healthy leaves from a different tree. The only consistent difference between unhealthy and healthy leaves was a very low manganese content of the unhealthy leaves.

Oat Plants.

(a) The six plots of a zinc and copper fertiliser experiment at two rates of application of superphosphate were sampled in July and in September, 1950. The use of a zinc and/or copper fertiliser did not materially affect the phosphorus content in the July or September samples. The use of a zinc fertiliser reduced the copper content of the plant in both the July and September samples and reduced the manganese content for the July samples receiving the lower rate of superphosphate, but did not affect the manganese content of the September samples. The use of a zinc fertiliser increased the zinc content of the plants in both the July and September samplings. The use of a copper fertiliser did not affect the manganese, zinc or phosphorus content at either sampling and for neither sampling was the use of copper with the zinc fertiliser effective in preventing the decrease in copper content due to the use of a zinc fertiliser. Analysis of the grain from this experiment showed no effect of the rate of superphosphate or the use of copper and zinc fertiliser separately or together on the phosphorus, potassium, copper or manganese contents. The zinc content was increased by the use of a zinc and/or copper fertiliser.

For the September samples the copper, manganese and zinc contents were one-half to one-third of those for the July sampling and the phosphorus content was one-third to one-quarter.

In a similar experiment at another farm sampled in September only, doubling the rate of superphosphate increased the phosphorus content of the plant, and increased the manganese content by some 50 per cent. The use of a zinc and/or copper fertiliser did not materially affect the phosphorus, copper or manganese content except for an indication that the use of a zinc and copper fertiliser slightly reduced the copper content of the plants. The zinc content of the plants was increased by the use of a zinc and/or copper fertiliser. Analysis of the oat grain from this experiment showed for the double rate of superphosphate plots, an increase in phosphorus and potassium but no difference in copper, manganese or zinc contents. The use of a zinc and/or copper fertiliser had increased the zinc content of the grain at both levels of superphosphate, but did not affect the phosphorus, potassium, copper or manganese contents. The use of a copper fertiliser did not affect the phosphorus, potassium, copper, manganese or zinc content of the grain.

(b) In another experiment the use of a zinc fertiliser did not affect the calcium, magnesium, nitrogen, phosphorus or potassium content of the plants sampled in July.

(c) A zinc and copper and rate of superphosphate fertiliser trial with oats was conducted by the Department of Agriculture in connection with the establishment of agriculture on the light land near Esperance. Samples taken in August showed—

- the copper content of the plant at both levels of superphosphate was reduced by the use of a zinc fertiliser and was not restored to the level of the superphosphate only plot by using copper fertiliser with the zinc fertiliser;
- the manganese content at both levels of superphosphate was markedly reduced by a zinc fertiliser used alone or with a copper fertiliser;
- the molybdenum content was increased by the zinc fertiliser with or without copper fertiliser for the low, but not for the high, rate of superphosphate;
- the zinc content at both levels of superphosphate was increased by the zinc fertiliser used alone or with copper fertiliser;
- the calcium and nitrogen contents were not affected by the fertiliser treatment;
- the magnesium content at both levels of superphosphate was reduced by the zinc fertiliser used with or without copper fertiliser;
- the phosphorus content was almost halved by the zinc fertiliser with or without copper fertiliser though the plants receiving two cwt. of superphosphate per acre contained slightly more phosphorus than did the plants which had received one cwt. of superphosphate per acre.

(d) Several groups of oat plants were analysed to assist in diagnosing the cause of abnormal symptoms in the plant.

(i) Yellow oats had twice as much manganese and phosphorus and some 20 times as much molybdenum as had green plants when sampled in July.

(ii) Yellow oats had less manganese, more phosphorus and some 20 times as much nitrate as had green plants when sampled in July.

(iii) White tipped oats sampled in September had about twice the copper content of oats which were not tipped.

(iv) Healthy plants sampled late in August had half the copper, equal manganese and zinc, nearly twice the molybdenum compared with adjacent unhealthy plants.

(v) Yellow-reddish oats 12in. high sampled in mid-October had more potassium, approximately equal copper and zinc and about half the molybdenum of adjacent green oats 18in. high.

Orange Tree Leaves.

All seven samples of orange tree leaves analysed were for aid in diagnosis. Of a group of three samples, the chlorotic leaves had slightly less ash and potassium than had two samples of healthy leaves, but had very much less magnesium. Of two samples, the yellowed leaves contained much less calcium, much more potassium and equal magnesium compared with the healthy leaves.

Of a further two samples, the yellowed leaves had slightly more ash and calcium, almost equal magnesium and potassium and slightly less manganese than had healthy green leaves.

Peach Tree Leaves.

Three samples of peach tree leaves were analysed for manganese, being (a) affected leaves (small, reddish) from an affected tree, (b) dark green leaves from an affected tree and (c) dark green leaves from a healthy tree. The manganese content of the affected leaves was approximately one-third of that of the healthy green leaves.

Potato Plants.

Three samples of potato plants were analysed for potassium and copper. The two healthy plants had more potassium than had the unhealthy plant but there was no marked difference in copper content although the unhealthy plant had received a dressing of copper sulphate. Indeed the unhealthy plant had slightly less copper than had the two healthy plants.

Vine Leaves.

(a) The Department of Agriculture forwarded samples of currant vine leaves taken at approximately monthly intervals from October, 1949, to April, 1950, from different vineyards selected to

cover the range of poor to good growth of the vines. Of the seven vineyards, two were classified as poor growth, two as medium and three as good. The leaves were analysed for calcium, magnesium, nitrogen, phosphorus, potassium, boron, copper, manganese, molybdenum and zinc. Samples of the pruning wood (pruned July-August, 1950) from these vines were also analysed.

For only two of the ten elements estimated was there a marked difference, consistent in time, between leaf samples from the different vineyards and even for these two elements there was not a good correlation with the classification of poor to good growth of the vines. One each of the two poor and the two medium growth vineyards had consistently low calcium values, but the other two had calcium values comparable with the good growth vineyards. The two poor growth vineyards and one of the two medium growth vineyards had consistently lower manganese values than the other vineyards. The second medium growth vineyard had a relatively high manganese content in the leaves early in the sampling period, October to late January, but in the early March and subsequent samplings had a manganese content lower than for the good growth vineyards, though not as low as for the poor growth vineyards.

For the pruning wood the good growth vineyards had much lower zinc values (15-21 p.p.m.) than the medium growth vineyards (53-63 p.p.m.) or the poor growth vineyards (34-63 p.p.m.).

For the leaf samples during the period October, 1949 to April, 1950—

calcium content increased steadily and markedly;

magnesium content increased steadily and markedly;

nitrogen content decreased steadily and markedly;

phosphorus content decreased steadily and markedly;

potassium content decreased steadily and markedly;

boron content was relatively unchanged.

copper content varied enormously, probably due to contamination from spraying operations, but for the three vineyards not showing this effect there was a steady decrease from October, 1949, to early March, 1950, and the late March and Mid-April samplings were approximately the same as in early March;

manganese content decreased steadily and markedly for those vineyards initially low in manganese, but was approximately constant for those initially high in manganese.

molybdenum content varied considerably between vineyards and with time from October to the late January samplings but was relatively the same for all vineyards in the early and late March samplings. For the mid-April sampling there was again a marked variation between vineyards but the differences were not consistent with the growth classification;

zinc content changes were not entirely consistent but generally there was a decrease from October, 1949, to late January, 1950, and relative constancy from late January to mid-April.

Comparison of the leaf values in mid-April, 1950, with those of the pruning wood (July-August, 1950) showed lower values for the pruning wood for magnesium, nitrogen, boron and molybdenum; much lower wood values for calcium and manganese; approximately equal values for phosphorus, potassium and copper. As already mentioned the zinc contents of the pruning wood were in two groups, low and high values consistent with the growth classifications; the good growth vineyards had very similar values for zinc in the pruning wood and the April leaf samples, but the poor growth vineyards had much higher zinc content in the pruning wood than in the April leaf samples.

(b) A trace element fertiliser experiment with vines included a basal treatment with nitrogen and phosphatic fertilisers and plots receiving zinc, potash, zinc and potash, potash and a mixture of trace elements, blood and bone. The experiment was in two halves, one half of the vines received a zinc swab and the other did not. There was no effect of treatment on phosphorus, potassium, copper, manganese or zinc content of the leaves.

Wheat.

(a) Samples (30) of wheat plants were received from a rate of superphosphate and rate of zinc oxide fertiliser trial conducted at two centres, one of the experiments being sampled in August and in September and the other sampled in July only.

For that sampled in July only, neither the rate of superphosphate nor the rate of zinc oxide affected the copper, manganese, calcium, magnesium, potassium or nitrogen content of the samples. The rate of application of zinc oxide did not affect the phosphorus content of the plants, but the use of zinc fertiliser did increase the zinc content, but four lb. per acre of zinc oxide did not increase the zinc content more than did two lb. per acre of zinc oxide. The rate of application of superphosphate did not affect the zinc content of the plant but plants receiving two cwts. of superphosphate per acre had 20 to 25 per cent. more phosphorus than those receiving one cwt. of superphosphate per acre.

Analysis of the grain from the lower rate of application of superphosphate section of this experiment showed no effect of treatment on the phosphorus, copper or manganese content. The grain from plots which had received zinc oxide had a lower potassium content and a higher zinc content and there were indications that these changes were greater when four lb. per acre of zinc oxide was used than when two lb. per acre of zinc oxide was used.

For the experiment sampled in August and in September neither the rate of application of superphosphate or of zinc affected the copper content of the plants at either sampling. Increased application of superphosphate did not affect the zinc content at either sampling but did increase the phosphorus content at both samplings. Increased application of zinc did not affect the phosphorus content at either sampling but did increase the zinc content at both samplings, two lb. per acre of zinc oxide being as effective as four lb. per acre. Comparing the September samples with the August samples the copper content was increased, the zinc content unchanged and the phosphorus content decreased.

(b) Samples (24) of wheat plant were received from a rate of superphosphate and application of zinc and copper fertiliser trials at two centres sampled in July and in September. The results from both centres were similar. Increased rates of superphosphate, or the use of a zinc or a copper fertiliser or the use of zinc and copper together did not affect the copper or manganese contents at either sampling. Increased rate of superphosphate did not affect the zinc content at either sampling and did not consistently increase the phosphorus content. The copper fertiliser did not consistently affect the zinc content but the use of a zinc fertiliser either alone or with a copper fertiliser did increase the zinc content of the plant. The use of a zinc or copper fertiliser either separately or together did not affect the phosphorus content of the plant.

Comparing the September and July samplings the September samplings had much the lower copper, manganese, zinc and phosphorus contents.

Analysis of the grain from these plants showed no effect of rate of superphosphate or zinc or copper or these two latter together on the phosphorus, potassium, copper or manganese contents. The use of a zinc fertiliser, either with or without copper, increased the zinc content of the grain at both levels of superphosphate.

(c) Samples (58) of wheat plants were received from three experiments at two centres to test sources of manganese as a fertiliser. At one centre increasing rates of manganese sulphate increased the manganese content of the plant, the increase being more marked in the July sample than in the September samples, the former having greater manganese contents than the latter. The use of manganese dioxide up to 40 lb. per acre did not materially affect the manganese content of the plant at either July or September samplings. At the same centre an experiment to compare manganese sulphate with a commercial manganous oxide (MnO) and sampled in September showed a more marked increase in plant manganese with increasing rates of manganese sulphate, but only a slight increase in plant manganese from the use of manganous oxide, with no difference between applications of 10 and 20 lb. per acre of manganous oxide.

At the second centre, the July sampling showed a marked increase in plant manganese from the application of manganese sulphate, no increase from the application of manganese dioxide and only a slight increase due to soaking the seed in a manganese solution. At the September sampling the plants were sampled in three portions, top leaf, second and third leaf from the top, heads and stalks. In each case the top leaf contained much more manganese than the other two portions which contained practically equal amounts. The differences between the top leaves were therefore much more marked than the differences between the simple averages of these three portions. For the top leaves, the use of 20 lb. of manganese sulphate per acre doubled the manganese content, the use of 20 lb. per acre of manganese dioxide gave some increase in plant manganese and the use of 100 lb. of manganese dioxide per acre almost doubled the manganese content. Analysis of the grain from this experiment showed no marked effect of manganese fertiliser on the phosphorus, potassium, copper, manganese or zinc content.

(d) Samples (16) of wheat plants were received from a trace element fertiliser experiment, sampled in July and in September, in which the fertiliser treatments were copper; copper and zinc; copper, zinc and boron; applied with one and two cwts. per acre respectively of superphosphate. The copper fertiliser did not affect the boron, or copper content of the plant at either level of superphosphate, but decreased the manganese, zinc and phosphorus content at both levels of superphosphate. The copper and zinc mixture did not affect the boron or copper content at either level of superphosphate but for both levels of superphosphate decreased the phosphorus content to the same extent as did the copper only fertiliser and decreased the manganese content below that of the copper only plants. The zinc content of the plants was increased for both rates of superphosphate. The copper, zinc and boron mixture did not affect the boron or copper content at either level of superphosphate but for both levels of superphosphate reduced the manganese and phosphorus content to the same extent as did the copper, zinc mixture. The zinc content of the plants at both rates of superphosphate was higher than the no zinc plots.

The rate of application of superphosphate did not affect the boron, copper, manganese or zinc content of the plants but plants from all the two cwt. of superphosphate plots contained more phosphorus than did the comparable one cwt. of superphosphate plots.

All trace element fertiliser treatments reduced the manganese and phosphorus content of the plants.

(e) In connection with the establishment of agriculture on the light lands near Esperance the Department of Agriculture conducted with wheat a zinc and copper fertiliser trial similar to those already referred to for barley and oats. The use of the trace elements did not affect the content of calcium, magnesium, nitrogen, phosphorus or potassium at either level of superphosphate. The use of zinc oxide with or without copper ore had no systematic effect on the copper, manganese or molybdenum content of the plants but plants from the zinc oxide with two cwts. of superphosphate per acre had a low copper content and high manganese content. Plants from the two cwt. superphosphate only plots had a low molybdenum content. The use of zinc oxide more than doubled the zinc content of the plants irrespective of the use of copper ore or the level of superphosphate. The use of two cwt. of superphosphate did not materially increase the phosphorus content compared with plants which received only one cwt. of superphosphate.

(f) Samples (four) of the top leaf were received from wheat grown on areas which had received copper, zinc, copper and zinc, fertilizers in 1947 but not since. There was a slight increase in the copper content of the plants from the plots which had received a copper sulphate dressing either with or without zinc sulphate. There was still an increase of some 50 per cent. in the zinc content of the plants from the plots which had received zinc sulphate either with or without copper sulphate. All trace element fertilisers reduced the phosphorus content of the plant, the reduction being greater for the copper plus zinc mixture than for the zinc only plot and this latter reduction was greater than for the copper only plot.

(g) There was no material difference in the copper content of two samples of wheat one of which was white tipped and the other was not.

Tobacco.

The work on some chemical aspects of tobacco growing in Western Australia under the five year financial grant from the Commonwealth Government was continued during 1950 along the same lines as in 1949.

(a) A selection of samples of tobacco leaf from the 126 samples referred to in my 1949 Annual Report, received from:

- a rate of application of potassium fertiliser in the 1946-47 season;
- a rate of application of potassium fertiliser in the 1947-48 season;
- a rate of application of magnesium fertiliser in the 1947-48 season;
- exploratory plots in the West Coastal Districts, 1947-48 season.

and which had previously been analysed for chloride, nitrogen, potassium, ash (total, acid soluble, acid insoluble), calcium and magnesium were analysed for invert sugar before and after inversion and for polyphenols.

For the Potash Experiment 1946-47 season there was no effect of fertiliser treatment on invert sugar before or after inversion, or on polyphenol content. There was a marked increase in invert sugar before inversion from the lugs to the middle leaves and a less marked increase from the middle to the top leaves. Because the increase in invert sugar by inversion was relatively small, similar increases from lugs to middle to top leaves was shown by the invert sugar after inversion. The polyphenol content was variable but on the average was independent of the position of the leaf on the plant.

Because inversion caused such a relatively small increase in reducing sugar there is a good correlation between the amount of invert sugar before and after inversion.

There was a general direct correlation between the nitrogen content and the invert sugar for the samples from the Tobacco Research Station, Manjimup, but no relation between the polyphenol content and either the total nitrogen or the invert sugar content.

(b) A series of 31 samples of tobacco leaf from Northcliffe, 1946-47 season, and 1948-49 season and from Karridale were analysed for chloride. The results were similar to those previously found. For the Northcliffe samples 1946-47 season the chloride content (per cent. on dry matter) ranged from 1.24 to 3.35 for the lugs, from 1.32 to 2.51 for the middle leaf and from 1.44 to 2.45 for the top leaf. Leaf from the Northcliffe plots, 1948-49 season,

showed a chloride content (per cent. on dry matter) of 2.45 to 4.18 for the lugs, 1.84 to 3.13 for the middle leaf and 1.65 to 3.18 for the top leaf. For three soil types at Karridale the chloride content of the leaf varied from 2.42 to 3.18 per cent. on dry matter.

(c) The individual leaves of a number of "hands" of tobacco leaf which had been previously sub-sampled and analysed were analysed separately and showed great variation in composition of leaves from the same experimental plot graded into the same hand.

(1) One hand of middle leaf from one plot of the Potash Experiment 1946-47 season (Plot 11, Block 4 of Treatment 1) contained 15 leaves of uniform appearance but the chloride content (per cent. of dry matter) varied from 1.06 to 3.90 with a simple average of 2.08 and a weighted average of 2.02 compared with a value of 2.79 obtained previously by sub-sampling by leaves.

(2) One hand of middle leaf from Plot 13 (Block 4 of Treatment 1) from the same experiment contained 12 leaves which were not of uniform appearance and were therefore graded 1-12 in order of (a) colour and (b) grey smudging. Each leaf was analysed for chloride, ash, calcium, magnesium and potassium with the results shown in Table 7.

TABLE 7.

	Range.	Simple Average.	Weighted Average.	Average by previous sub-sampling.
		Per cent on dry matter.		
Dry weight (g)	4·5 – 7·6	....	....	....
Chloride, Cl	2·64– 5·54	3·76	3·69	3·59
Lime, CaO	4·10– 5·93	5·03	5·00	4·64
Magnesia, MgO	1·53– 3·31	2·37	2·34	2·41
Total ash	11·6 –16·3	14·6	14·5	12·4
Acid soluble ash	11·0 –15·6	13·9	13·8	11·9
Acid insoluble ash	0·39– 1·13	0·70	0·70	0·57
Potash, K_2O	0·61– 1·25	0·90	0·88	0·97

There was no relationship between any of the analytical values and either the order of leaf colour or the order of the amount of grey smudging on the leaf. There was evidence of a direct relation between chloride and magnesia and between lime and ash.

(3) One hand of lugs from Plot 13 (Block 5 of Treatment 1) from the same experiment contained 11 leaves and these were analysed individually for chloride, calcium, magnesium, ash and potassium with the results shown in Table 8.

TABLE 8.

	Range.	Simple Average.	Average by previous sub-sampling.
		Per cent. on dry matter.	
Chloride, Cl	2·95– 6·43	4·83	5·10
Lime, CaO	6·00– 9·32	7·67	7·28
Magnesia, MgO	2·55– 5·19	3·87	3·82
Total ash	17·5 –27·7	20·7	18·9
Potash, K_2O	0·88– 2·84	1·47	1·39

For this hand also there was evidence of a direct relationship between chloride and magnesia.

(4) One hand of lugs from Plot 14 (Block 5 of Treatment 2) of the Potash Experiment 1947-48 contained 12 leaves and these were analysed separately for chloride, lime, magnesia, ash and potash and the results showed variations similar to those in Tables 7 and 8, but there was no evidence of any relationship between any of the analytical data.

(5) One hand of lugs from Plot 5, Treatment 1 of the Magnesium Experiment 1947-1948, Grade B_2M. contained 14 leaves which were analysed individually for chloride and nitrogen. The chloride (per cent, of dry matter) varied from 2.23 to 6.29 with a simple average of 4.36 compared with the value of 4.82 previously obtained by sub-sampling by leaves. The nitrogen (per cent. on dry matter) varied from 1.57 to 2.34 with a simple average of 1.96 and a weighted average of 1.96 compared with the value of 1.91 obtained by previous sub-sampling by leaves.

(6) One hand of middle leaf from Plot 5 of the exploratory plots at Northcliffe 1948-49 season contained 9 leaves and these showed a variation in chloride (per cent. on dry matter) from 1.32 to 3.94, with a simple average of 2.77 and a weighted average of 2.82 compared with a value of 2.58 obtained by previous sub-sampling by leaves.

(d) The sampling and analysis of the soils from the Tobacco Research Station, Manjimup was discussed under "Soils."

Wheat.

(a) Samples of the Western Australian official f.a.q. wheat sample for the 1949-1950 season and of the flour milled experimentally from it on a stone mill were analysed (Table 9).

TABLE 9.

	Wheat.	Flour. Stone Mill.
Moisture, per cent. (1 hour at 130°C)	11·6	14·2
Protein, per cent. N x 5·83	9·91	....
N x 5·7	....	8·6
Ash, per cent.	1·26	0·55
Gluten, per cent.—		
Wet	....	25·4
Dry	....	8·5
Maltose figure (Kent Jones)	....	1·76

Samples of wheat from each of the four zones which were included in the State f.a.q. were also analysed for nitrogen.

(b) Nitrogen determinations were made on four samples of wheat grain from the Department of Agriculture's cross-breeding programme.

(c) Samples of wheat from five shipments of export wheat were also analysed for nitrogen.

(d) Samples (eight) of wheat grown on (a) fallow and (b) old clover land were analysed for calcium, phosphorus and the usual feeding stuffs constituents. There were four varieties and for each variety the sample from old clover land contained some 2 per cent. more protein than did that grown on fallow.

(e) The comprehensive rotation and grazing trial at the Wongan Hills Agricultural Research Station completed its first four year cycle (1946-49) and 28 samples of wheat grain from the experiment were received and analysed for nitrogen. The wheat grown after volunteer pasture had the lowest nitrogen content (average 1.38 per cent., dry basis) and that grown after a mixed pasture of subterranean clover and Wimmera Rye grass had the highest (1.72 per cent., dry basis). Wheat grown after (a) oats annually (average 1.55 per cent. N) (b) oats and peas (two sections, average 1.49 and 1.56 per cent. N respectively) and (c) oats and lupins (two sections 1.50 and 1.53 per cent. N respectively) had similar nitrogen contents.

MINERAL, MINERAL TECHNOLOGY AND GEOCHEMISTRY DIVISION.

Annual Report for the Year ending 31st December, 1950.

By C. R. LeMesurier, A.W.A.S.M., A.A.C.I.
Deputy Government Mineralogist.

One thousand, one hundred and nineteen (1,119) samples were received for examination during the year, a decrease of 167 from the previous year's total. The main sources of samples were as follows, the corresponding figures for the previous year are given in brackets:—Assays and determination for the general public, free 387 (531); pay, 152 (148); State Batteries, 289 (200), and Government Geologist, 97 (145).

Alloys and Metals.

During the year a number of corrosion problems have been investigated with the result that recommendations have been made which will, it is hoped, minimise this costly and troublesome phenomenon.

Most of the cases investigated have originated in the coupling of dissimilar metals in an environment favourable to the setting up of galvanic action, with consequent solution of the least noble metal.

As an example:—Welds on the interior of a copper hot water service tank in a government institution failed after about two year's service while those on the exterior were sound. Analysis of the sound weld metal showed it to be a high zinc brass containing 35.8 per cent. zinc, while the affected weld metal had lost all but 4 per cent. of its zinc content. The water in the tank is maintained at a temperature of about 140°F. and is supplied from Perth mains, this water has a chloride content sufficiently high to form a good electrolyte.

As a result of similar failures in welded copper piping of the hot water and refrigeration services of the same institution tests were carried out on alternative welding metals by measuring the E.M.F. of copper-welding-rod couples in running water at temperatures up to 180°F. Tests were also made with copper-tobin bronze welding rod for comparison.

Results were as follows:—

Copper-Silver brazing alloy No. 1.

Duration of test—four hours.

The copper was anodic to the brazing alloy. The E.M.F. rose rapidly with temperature increase between 169° and 181°F. to a maximum of +21 millivolts at 181°F. Thereafter the E.M.F. showed a tendency to drop and while responding to temperature increase a steady slow decrease in E.M.F. at constant temperature was apparent.

Copper-Phosphor-copper.

Duration of test—four hours.

The copper was anodic to the phosphor-copper. The E.M.F. rose to + 4 millivolts at 180°F. and remained practically constant at that figure independent of the temperature.

Copper-Tobin bronze (high zinc).

Duration of test—five hours.

The copper was cathodic to the bronze with a voltage several times that of the other couples tested, with a maximum of 122 millivolts by the end of the test.

These tests show that while the high-zinc tobin bronze is *anodic* to copper, silver brazing alloy No. 1 and phosphor-copper are both *cathodic,* i.e., in the first instance the weld is sacrificed while in the latter it is the copper which will tend to corrode. Since, however, the E.M.F. is much less, and the area of copper affected is much greater than the weld, little corrosion will take place.

Analysis of weld material from a refrigeration pipe line still in good condition showed it to consist of Cu 60 per cent., Sn 1.1 per cent., Zn remainder. Tin, usually added to the extent of 2 per cent. is known to inhibit, or greatly reduce dezincification in brasses.

Check valves from the hot water system of the same institution caused considerable trouble through failure of the valve spindle. Analysis of the valve components showed that, while the valve body and pairs were of bronze containing 6-8 per cent. tin and not more than 4 per cent. zinc, the spindles were of brass of composition Cu 55.2 per cent., Zn 42.4 per cent., Sn 1.3 per cent. and when galvanically coupled with the main valve components were anodic to them.

A sample of corroded copper tube heating element from the heat exchanger of this hot water system was examined to ascertain the cause of corrosion. Live steam passes through the heating elements which are enclosed in a cylindrical copper vessel fed with warm water from the hot water storage tank. The temperature of the water leaving the exchanger is about 180°C. Examination of the corrosion product, which occurred on the exterior of the tube, showed it to consist of minute bluish crystals of cuprous oxide.

Most, though not all, of the corrosion occurs at the hot end of the tubes where the temperature of the water is about 180°F., at which temperature considerable air is expelled, forming bubbles which tend to cling to the tubes, and apparently result in the formation of oxide.

A badly corroded brass container and spray pump used for spraying fruit-fly bait was submitted by the Agricultural Department for determination of cause of corrosion and tests of various protective coatings.

Spraying solution made up with a sample of the sodium fluosilicate supplied to the strength used in the field had a pH 3.26, which is sufficiently acid to cause the rapid dezincification of the brass observed.

Test strips of metal treated with various acid resisting coatings were subjected to alternate immersion and drying in the spray solution with the following results:—

Coating.	Remarks.
a. Beco plastic, sprayed	Good resistance but subject to pinholes.
b. Rubberised paint, brushed	Good resistance.
c. Elastikon bituminous paint (Sherwin Williams), brushed	Good resistance.

Phosphate Panel Washes.

At the request of the Bridges Engineer, Main Roads Department accelerated tests were made on the effect of treatment of structural steel with Walterisation R.S.I. solution and a similar preparation named Rust Prym.

The purpose of these preparations, which are said to contain phosphoric acid and a reducing agent is to convert rust and mill scale to phosphate, whereby it is claimed that rusting is inhibited and an excellent surface for paint bonding produced. The process is designed primarily for treatment of existing structures which are difficult to clean free of rust in other ways.

Accelerated tests were carried out in a fog chamber assembled from material available on the spot and while the chamber does not comply with the A.S.T.M. specifications for this test, constant temperature was maintained and comparative results obtained.

Cast Iron Pipe and Pig Iron.

A sample of cast iron pipe too hard to machine, and of pig iron from the charge used were analysed for Si and C contents. Silicon content was below the percentage specified by the foundry.

Ceramics.

Clays.

Complete clay tests were made on four samples of clay from Collie. Two of these, one from the Black Diamond open cut, the other from the Western Collieries open cut are refractory kaolinitic clays, the former burns to a good white at 1150°C the latter to a creamy white. The other two clays, one from each of the localities already mentioned are refractory semi-ball clays, neither of which burns to a good white at 1150°C. Both types of clay are typical of the interbedded clays of the Collie district.

Mechanical analyses and determination of plasticity were carried out on eleven samples of clay from Darwin to determine their suitability or otherwise for brickmaking.

A partial burning test of a red clay from Dalwallinu showed that it contained too much grit to be of any value for brick making.

Partial analyses were made on clays from Aldersyde district and Mt. Kokeby.

Refractories.

Magnesite.

Three samples of magnesite, two of them calcareous were analysed with the following results:—

Lab. No.	4571/50.	8465/50.	8932/50.
Locality	20 m. S.E. of Wuraga.	½ m. S.E. of Meekatharra State Battery.	Wolgidee Hill, about 20 m. N. of Noonkahbah Station H.S.
	%	%	%
Insoluble in acid	0·79	1·36	(silica) 1·22
Lime, CaO	4·57	0·55	9·58
Magnesia, MgO	43·73	46·49	38·49
Equivalent to Calcium carbonate, $CaCO_3$	8·16	0·98	17·10
Magnesium carbonate $MgCO_3$	91·46	97·27	80·50

The material from Meekatharra is of high grade, but no details of the extent of the deposit are known.

Dolomite.

Only two samples of dolomite, both too impure to be of value, were received during the year.

Kyanite.

One sample of kyanite bearing rock was received from a locality 16 miles west of Manjimup. It contained only 6 per cent. of Kyanite. Analysis was made of Kyanite brick manufactured by a local firm.

Spongolite.

A sample of spongolite was received from a locality given as about 20 miles east of Bremer Bay. The material, which consists mainly of opaline sponge spicules and other opaline organic remains, though somewhat friable can be sawn into blocks without undue loss.

Test blocks burnt to a temperature of 1350°C showed a linear shrinkage of only 3.7 per cent. and a porosity of 63 per cent. It is therefore suitable for high temperature insulating blocks provided they are not subject to abrasion.

The calcined material, when ground, has good clarifying qualities and compared favourably with imported high grade diatomite.

Firebrick and Silica Brick.

Ten samples of locally made firebrick and silica brick were tested for shrinkage on firing and porosity and the silica bricks examined microscopically to ascertain degree of conversion to cristobalite. Analyses were made of four firebricks and a silica brick. Most of this work was carried out in conjunction with the Fuel Technology Division. As a result of these tests the firebricks in the boiler setting of a coastal vessel operated by the State Shipping Service have been replaced with bricks of local manufacture with beneficial results.

Natural Mineral Pigments.

Ochres and Red Oxides.

Three samples of ochres were tested for pigment value but all were deficient in iron oxide content and hiding power. Two samples of red oxide milled by a local firm were analysed for ferric oxide content, these were of high standard.

Metallic Ores and Minerals.

Beryllium.

Five specimens thought to be beryl were submitted for determination, only one, from the vicinity of Spargos Reward, Coolgardie G.F. was of marketable grade.

Copper.

Interest in copper was maintained and 66 samples of copper ores and concentrates were submitted for assay. The majority of ores submitted were from known copper bearing localities, many of them too remote to allow of profitable development unless a high grade concentrate can be produced at low cost.

Although the values of many of the samples were high, up to 40% copper, the returns for copper ores mined rarely average 10% copper, indicating that prospectors, when sampling a find, are too prone to select specimen ore, thereby creating a false impression of the value of the deposit.

Gold.

Four hundred and two gold ores and mill products were received for assay, an increase of one hundred on last year's figures and comprising gold ores 140, State Battery tailings 208, State Battery umpires 52, other mill products 2. Lime and cyanide consumption tests were carried out on three samples, and a cyanide extraction test on one of them.

Heavy Sands, Ilmenite, etc.

Only nine samples of heavy sands were received during the year of which only one, from the vicinity of Denmark, is potentially valuable by reason of its zircon content, amounting to 28%. There does not appear to be as yet any market for West Australian ilmenite sand.

Iron Ores.

Analyses were carried out on forty-eight samples of iron ore, thirty-four of which were in connection with the South West iron ore survey.

Lead and Lead-Zinc Ores.

Five samples of lead and lead-zinc ores and twelve samples of lead mill products were submitted for assay, in addition, several specimens forwarded for mineral determination contained lead.

Manganese.

Twelve samples of manganese ore were submitted, eight of which were from undisclosed localities or deposits held under lease. A sample from Kings Creek, Nullagine, consisted of well crystallised polianite (manganese dioxide) intergrown with quartz, another, from Balfour Downs Station was found to be mainly psilomelane with some crystalline manganite (hydrous manganese sesquioxide). This is the first record of manganese ore from this locality.

Chromite.

Eight samples of chromite, all from the Coobina deposits five miles E.S.E. of Jimblebar, N.W. were received.

Several of the samples, representing a considerable tonnage of chromite are high grade and contained 50% Cr_2O_3 but the ratio of Cr_2O_3 to FeO is lower than specified for refractory grade which requires a ratio of 3:1. This ore should, however, satisfy the requirements for metallurgical chromite.

Tantalite and Columbite.

Four specimens of columbite and two of tantalite were submitted for determination, these were all from localities in which occasional specimens of these minerals have been found, but no quantity produced. In addition four samples representative of shipments of tin-tantalite concentrates from the Greenbushes tin field were assayed for combined tantalic-niobic pentoxide content. The percentage of $(TaNb)_2O_5$ in these samples varied between 10% and 15%, shipment to overseas smelters is allowable only for concentrates containing 2% or more $(TaNb)_2O_5$.

Tin.

In spite of the increased interest in tin resulting from the extremely high market price no finds of any importance have been reported.

Two samples of concentrates from a locality given as between Yandyarra and Kangan had the following approximate composition.

	A. App. %	B. App. %
Cassiterite	57.5	18.5
Almandine-spessartite garnet	28.5	51.0
Columbite	3.5	2.0
Ilmenite	3.0	5.0
Monazite	3.0	5.0
Limonite	1.5	....
Magnetite	1.5	2.0
Quartz	1.0	6.5
Zircon	0.5	10.0

Cassiterite has been found in alluvial workings on Friendly Creek which joins the Yule River in this area, it was associated with high gold values, but two concentrates examined in this laboratory in 1928, contained neither garnet nor columbite.

A sample of concentrates from the North bank of Pilbara Creek about 7 miles from its junction with the Yule River contained approx. 90% cassiterite associated with small amounts of columbite, haematite, monazite and magnetite.

Wolfram (tungsten).

Fifteen samples of wolfram ore were assayed for tungstic oxide content. The cessation of supplies of this metal from Korea and almost world wide rearmament have caused a critical shortage and the market price has almost doubled since July, the average London quotation for December being 330s. per unit for 65% WO_3 concentrates.

Other Economic Ores and Minerals.

Alunite.

During the latter part of 1949, investigations were commenced in association with officers of the State Alunite Industry on the lime-sinter process applied to the extraction of alumina and potash from alunite residues and in the year under review twenty samples of sinter were analysed for extractable alumina and sulphur.

Bentonite.

Two samples of highly bentonitic clays were received, one from a lake 40 chains west of Gunyidi, 143 miles from Perth, on the Midland line, and the other from a lake 15 miles East of Gunyidi. Although of somewhat higher grade than the Marchagee material they are reported by the Government Geologist to be of very limited extent.

Glauconite.

A sample of greensand from a well on private property at Chittering contained 30 % glauconite. The greensand was struck at a depth of 15 feet and was still in evidence at 35ft. Although of lower grade than the best Gingin greensand which approximates a glauconite content of 50%, this material is probably of much the same grade as the average treated. This is the first record of glauconite from Chittering.

Limestone.

Seventy-two samples of limestone were received during the year for analysis. Of these, 55 were submitted by the Government Geologist in connection with the S. W. Limestone Survey (reported in Geological Survey Annual Report), six were for the University of Western Australia and the remainder for private persons.

Mineral Notes.

In addition to those already listed, the following minerals examined during the year are of interest.

Andradite—Grossularite Garnet.

From two miles North of Marvel Loch in quartz veins. It is in part massive, in part as well-developed lustrous black dodecahedral crystals of specific gravity 3.70. Under the microscope the crystals are seen to consist of a pink isotropic centre with a green, anisotropic outer shell. A partial analysis indicated that the andradite (lime-iron garnet) and grossularite (lime-aluminium garnet) molecules are present in approximately equal ratio. This is the first reported occurrence of either andradite or grossularite garnets from this area although garnets of the almandine-spessartite types are common.

Antimony ochre and cervantite (antimony oxide).

From Jilawarra, about 40 miles W.N.W. of Meekatharra, a small specimen consisting of black impure antimony ochre and yellow cervantite, the circumstances of occurrence are not known. This is a new locality for antimony.

Chrysotile Asbestos.

A serpentine rock from a depth of four feet on Copper Hills 3½ miles S. E. of Gabanintha, Murchison Division, contained occasional fine veins of chrysotile associated with magnetite and chromite. The chrysotile is of no value but as the specimen is from the weathered zone better quality material may be located at depth. This is the first record of chrysotile from the Murchison Division.

Native Sulphur.

Small crystals of native sulphur were observed lining vughs in lead ore from a lode about 1 mile North of Baddera. The lead occurred mainly as anglesite and cerussite with a little galena and was associated with small amounts of quartz, natrojarrosite, limonite and carminite, the last named being a rare arsenate of lead and iron reported previously from the Hardy River, a tributary of the Ashburton.

Building Materials.

Asbestos-Cement Sheet.

Samples of asbestos-cement flat sheet from three shipments of Italian manufacture were submitted by the State Housing Commission for examination. Sheets from one shipment in particular warped badly and split along the centre nail line when exposed to rain. The samples, including one of local manufacture for comparison, were examined for cement and fibre content in the following manner:

Portions of each sheet were disintegrated by repeated passes through rolls using light pressure, followed by gentle rubbing in a mortar. The cement was dissolved by cold dilute (1:4) hydrochloric acid followed by hot sodium carbonate solution. The separated fibre was then sieved wet on a sieve of 70 mesh per linear inch and the two fractions dried at 110°C and weighted. The portion remaining on the sieve consisted of fibres 0.07 to 4.0 mm. in length, and that passing the sieve of fibre less than 0.07 mm. in length with a considerable proportion of fine quartz grains.

The fibre was mainly chrysotile with a little crocidolite (blue asbestos).

Results are as follows:—

Approximate Composition.

Shipment	A.	B.	C.	Local.
Condition	No warp.	Bad Warp.	Slight Warp.	No Warp.
Long fibre	5·0 %	4·4 %	4·1 %	4·0 %
Short fibre and fines	12·3 } 17·3	19·0 } 23·4	13·1 } 17·2	5·6 } 9·6
Cement (dry basis, by difference)	61·8	57·0	60·8	66·4
Loss on ignition	20·9	19·6	22·0	24·0
	100·0	100·0	100·0	100·0
Ratio cement-fibre and fines	3·6	2·4	3·5	7·0

From these results it appears that the excessive content of fines in shipment B is responsible for the tendency to warp.

Samples of corrugated asbestos-cement sheet of English manufacture which was said to leak badly were also submitted for examination. The sheets examined showed extensive tension cracking on the top side of the ridges but the permeability of the cracked areas was not appreciably greater than that of the undamaged surface. Results of tests of English and local sheets are as follows:

Mark.	English.	Local.
Apparent Porosity, %	36	41
Absorption, %	21	25
Permeability, mls. per Cm_2 with 5 Cm head—		
In 8 hours	0·17	0·29
In 72 hours	0·77	1·55
Approx. fibre content, %	6·6	9·0

The lower absorption and permeability of the English sheet is due partly to carbonisation of the cement by ageing and partly to carbonisation of cement-fibre ratio. The fibre content is lower than normal and would result in lower tensile strength.

Leaks are apparently due to damage to the rather brittle sheets during fixing.

Wall Floating and Plaster.

Examination of a sample of wall floating with discoloured plaster finish showed that the floating was abnormally low in lime and was porous and lacking in strength. The discolouration of the

plaster was due to iron oxide, probably drawn to the finished surface from the very porus floating by capilliarity. Plaster on cement-rendered walls showed no discolouration.

Sand for Aggregate.

Sieve analysis and examination were carried out on four samples of sand to determine suitability for cement brick making.

Autoclaved Asbestos-Cement Pipe.

During the year preliminary tests were carried out on pilot plant samples of autoclaved pressure pipe.

These pipes differ in mode of manufacture and composition from the Sutton fibrolite pipe extensively used in the metropolitan and country water supply mains, in that the pipes are formed on a hollow, perforated mandrel, through which the excess water is drawn off by vacuum, and the composition is altered by replacing 40% of the cement by finely ground quartz sand which, on autoclaving, combines to a certain extent with the hydrated lime in the cement to form monocalcium silicate. The calcium aluminate in the cement is also affected by autoclaving, resulting in greater resistance to sulphate attack which has in the past caused considerable damage to existing lines.

Results of tests indicate that the autoclaved pipes possess superior resistantce to water leaching and sulphate attack, but before any definite conclusion can be drawn confirmatory tests should be made on standard size pipes when these are available.

Health Hazard.

One sample of dust from a mullock winze delivering oxidised ore was analysed for free and combined silica.

Photomicrographs were made of three samples of wheat dust taken with a Watson konimeter during bulk handling operation. Magnification was X500 and counts show many particles, probably of the order of a half to one mu (one-thousandth millimeter) which are not detected by the konimeter reading in diffused daylight.

INDUSTRIAL CHEMISTRY DIVISION.

Annual Report for the Year Ending, 31st December, 1950.

By A. Reid, M.A., B.Sc., A.R.I.C., Chief Industrial Chemist.

I.—Introduction.

Accommodation.

1. The Division continued to occupy the same cramped accommodation as in the previous year but good progress has been made in the designing and planning of the proposed Unit Process Plant and Laboratories. It is hoped that these will be under construction in 1951.

2. The nature of the accommodation and equipment available has influenced the direction in which the Division's major activities have progressed. Research, particularly developmental research, has been restricted while information services have gone ahead. Just over 800 queries, mostly by telephone, were received during the year. It was found possible to answer the greater majority of these queries, or to direct the enquirer to a known source of information. The co-operation of manufacturers and consumers of chemical supplies in answering queries is very much appreciated.

II.—Classification of Work.

3. The year's work may be considered under the following headings:

(i) Information service.

(ii) Developmental work for new and established industries.

(iii) Research.

(i) Information Service.

4. As recorded, some 800 queries were received in the course of the year. They mainly relate to raw materials (sources, properties, suitability and availability); finished products (sources, properties and suitability), materials of construction, potential markets, and minor difficulties of manufacture. The enquiries ranged from temperature conversions to the properties of ethyl acetyl ricinoleate; the setting-up of an electroplating shop; solvents for polishes; stearates for water-proofing. It was possible in almost every case either to answer the enquiry direct or to introduce the enquirer to a source of information.

(ii) Developmental Work.

5. We quote below some examples of the work done in this connection. As much of the information given by clients on their problems was of a confidential nature it is not possible to describe their problems, or their solutions in detail.

6. At the request of a manufacturer of agricultural products a formula was developed for a water-dispersible preparation containing 20% gamma isomer of benzene hexachloride. A similar preparation containing 10% of D.D.T. together with 5% isomer of B.H.C. was also formulated.

7. Following enquiries on the subject by a number of interested parties some experimental work was done on the production of magnesium oxychloride cements. A suitable magnesium oxychloride liquor was obtained by the acid treatment of calcined Coolgardie magnesite; cost of production would be rather more than liquor made from imported magnesium chloride of French origin.

8. Two manufacturers of cement blocks had difficulty with cement sticking in the moulds. They were recommended to a supplier of a suitable oil dressing, with successful results.

9. Trouble in the finishing of aluminium castings was reported by a client. He was referred to technical articles on the subject and the difficulty was resolved by modification of the welding methods.

10. A bore hole drilled in the North West encountered the twin troubles of lost circulation and inflow of highly mineralised water. It was necessary to cement the hole before directional drilling could be attempted. Attempts with ordinary cement failed. The problem was discussed with the drilling superintendent and a technique worked out using portland cement heavily treated with bentonite. This proved completely successful and the bore-hole was completed. Failure would have meant abandonment of the hole at a considerable loss of money.

11. A drilling mud problem at Collie concerned the behaviour of the drilling mud. The trouble was due to too low a pH: when this was corrected no further trouble was encountered with the mud. In the course of laboratory investigations it was found that Marchagee bentonite treated with sodium carboxy-methyl cellulose made an excellent drilling mud.

12. A manufacturer of a water-base paint presented an interesting problem. Mixed on a small scale the paint was completely satisfactory but on full-scale, crystals appeared in the paint. Solving this problem provided a very useful exercise in physical and inorganic chemistry. The temperature control and the use of an ingredient in the liquid, rather than the solid form, completely solved the problem. This paint is now being manufactured on a steadily increasing scale and finds a ready market, particularly in the Eastern States.

13. There are a number of small manufacturers of polishers, abrasives, domestic cleaners, etc., in the State. Most of these have consulted the Division in regard to problems of formulation, manufacture, and choice of raw materials. It has been possible to provide the information required, and as a result one or two small but profitable businesses have been established. The market for such goods is, however, a very close one and the ultimate establishment of a big concern manufacturing these lines is unlikely.

14. For many of the development problems raised by small manufacturers very little laboratory work is necessary but it is essential that the Division be not only well informed as to materials available but also be acquainted with the relevant properties of these substances. In this respect it is a pleasure to record the willing co-operation of suppliers who have provided several of the Division's clients with information and often with samples. As a result there has been built up in one or two cases an association which appears profitable to both supplier and manufacturer.

(iii) Research.

15. The little work possible was concentrated on two subjects: (a) Rottnest salt and (b) lime sands.

(a) Rottnest Salt.

16. Some work has been carried out on the preparation of table salt from crude Rottnest salt. Owing to the geographical location of the deposit, on an island where manufacturing requirements, such as power, are not so readily available as in, say, the Metropolitan Area, and since the price of the finished product is not high, any economic manufacturing process must be cheap and simple. By washing the crude salt (sodium chloride content 99.4%) with a brine made from the crude salt it is possible to obtain a product of 99.9% purity. It remains to discover the exact conditions of temperature, time of contact and grain size which will give maximum results. This work has unfortunately been delayed by the non-arrival from the Eastern States of a thermostatically-controlled bath. All that can be said at the moment is that the economic production of a high-grade salt from Rottnest seems possible.

(b) Lime Sands.

17. A sample of silt from Leschenault Inlet was examined as raw material for cement. Proportions were calculated and a trial mix burnt in a muffle furnace. The chemical composition of the product was satisfactory but the cement failed to set. The matter was not followed further.

18. A report was prepared on limestone formations in the South West with a view to their suitability for portland cement. With the exception of oyster shell beds the available materials are generally not sufficiently high-grade for this purpose. Attention was directed to the possibility of beneficiation by some process which would remove the free silica. Flotation appears promising and further work on this is proposed.

FUEL TECHNOLOGY DIVISION.

Annual Report for the Year Ended 31st December, 1950.

By R. P. Donnelly, M.A., B.Sc. (Oxon), A.M.I. Chem. Eng. E.M. Inst. Fuel, M. Inst. Gas Eng., A.A.C.I.

Fuel Technologist.

Introduction.

During 1950 a first survey of all working coal faces at Collie has been made in detail. A considerable volume of analytical work has been done in connection with the Government Geologist's drilling surveys. Work on coal washing and blending has been commenced at Collie. Progress in the manufacture of carburetted water gas from raw coal has been forwarded with the help of the Fremantle Gas Company who have given us free access to their works for experimental purposes. An experimental producer gas plant has been installed at the laboratory. Other valuable work has been done in boiler trials with various Collie coals, especially with the West Australian works of Colonial Sugar Refineries and the Swan Brewery Company. Closer co-operation with Government undertakings is being gradually established; with the State Engineering Works in work on cupolas; with the Government Railways on the characteristics of different coals on locomotive boilers, and to a more limited extent with the State Electricity Commission. It has been learnt from all these contacts that there is wide scope for greater use to be made of the facilities of the Fuel Laboratory to extend the use and increase the efficiency of the utilisation of Collie coal. This applies to Government utilities, especially, since they can effect savings of considerable tonnages by even slight increases in consumption efficiencies because of their position as major users of coal.

The difficulties in getting close co-operation are not unusual in industry. They are characteristic of a particular phase in the industrial development of a community in which its engineering faculty has acquired skill in running their processes or machinery but, through lack of opportunity, has not benefited from the services of applied chemical and physical research. Such research never costs proportionately very much, even where it fails. If it succeeds it can at times effect major decreases in costs or increases in profits. As an instance it is within the scope of the Fuel Laboratory, if its services are properly used, to reduce the fuel costs of industry in this State by at least 10 per cent.

Work on briquetting receives regular attention and it is hoped to finalise research on this project in the course of the present year.

Work on testing of refractories has been undertaken in conjunction with the Deputy Government Mineralogist and some valuable properties of Western Australian firebricks and other refractories have been characterised. Useful work has alone been done in practical application in conjunction with the superintendant of the State Shipping Service and it is evident that in the State there is room to set up the close and valuable co-operation between refractory brickmakers users and refractory research which exists elsewhere in industrial environments.

Work on sawdust fired boilers undertaken intermittently over the course of the past three years has been finalised and is reported in a separate appendix. The extremely valuable point which emerges is that sawdust, which in this State is a waste material of no commercial value, is an easily fired, free burning fuel capable of giving high rates of combustion and evaporation on boilers.

Two papers have been accepted for publication. One on "Modifications to the Gooderham Continuous Flow Gas Analysis Apparatus," the other on a "Miniature Gas Calorimeter," these are to appear in due course in the Journal of the Society of Industrial Chemistry and the technical paper "Fuel."

The laboratory staff now comprises a total of eight chemists and assistants who have now acquired skill and background experience as fuel chemists. In consequence the output of work from the laboratory is considerable and of a useful standard. The Division has also matured to an asset of value to industrial and State utilities which as yet is exploited only to a far too limited degree.

1.—Survey of Working Faces at Collie.

Coal has been analysed from a total of 42 sampling points at Collie, comprising 57 samples, distributed adequately over the working places of eight deep mines and four open cut seams. Proximate analyses, calorific value determinations, carbonisation assays, ash analyses and ash fusion determinations have been made on these samples and the results are reported in Tables 1, 2, 7, 8, 9, and 10. Ultimate analyses are not reported as they are not regarded as being completely reliable since the coal samples had deteriorated slightly in an enforced period of storage. In future sampling this deficiency will be eliminated.

New information on the Collie field which has emerged from the Survey is:—

(1) That the majority of open-cut seams at Collie are of low ash content:—

Seam.	% Ash.	
Black Diamond	5.2 — 9.0%	in small coal.
East Collieburn	5.4	
Stockton No. 1	13.60	12.3% in small coal.
Stockton No. 2	6.90	

Stockton No. 1 is the exception. Even here the high ash is associated mainly with a band of batt between one and three feet thick containing

23-24 per cent. of ash. This batt lies on top of the seam immediately under the overburden from which it can readily be stripped. The underlying coal contains only 9.85 per cent. of ash.

In general, batt in coal causes trouble and noticeable dirty fire condition out of proportion to its actual contribution to the ash in coal; conversely its removal as completely as possible in mining will similarly enhance the market opinion of a coal.

(2) Mineral inclusions, mainly of compounds of iron such as Siderite ($FeCO_3$) Pyrite and Marcasite (FeS_2) and Melanterite ($FeSO_4$) to some or all of which have been seen ascribed by users in the past properties of producing excessive clinker are found in all coal seams at Collie. Their influence, if any on clinkering is then not specific to any one coal.

They occur in thin veins about 1/16th in. thick and are perhaps more noticeable in some seams than in others. Quantitive estimation places them at less than 1.0 per cent. of the coal even in conspicuous occurrences.

(3) A point of major interest which has emerged is the clear division of Collie Coals into high and low ash fusion point coals Table 7, 8, 9, and 10.

(A) High Ash Fusion Point—

	Temp. of Blobbing. Reducing Atomsphere.
Black Diamond	Above 1600°C—2912°F
East Collieburn	Above 1600°C—2912°F
Cardiff	At 1480°C—2696°F

(B) Low Ash Fusion Point—

Griffin	1100°C—2012°F
Phoenix	1238°C—2260°F
Proprietary	1110°C—2030°F
Co-operative (East)	1190°C—2174°F
Co-operative (West)	1165°C—2129°F
*Stockton No. 1 seam	1155°C—2111°F
Stockton No. 2 seam	1165°C—2129°F

In the light of this classification it follows that coal of group A can be blended with coals of group B to produce coals whose ash residues will have intermediate ash fusion points. A number of coal properties are related to ash fusion point and the existence of the two ash types widens the scope of the uses of Collie Coal considerably.

(4) Tar contents of all the coals are poor and the quality and yields of gas from carbonisation are low. None of the coals shows any tendency to coke. Detailed information as set out in the tables of carbonisation assays (Table 2). It is seen that the coal from the Griffin, Wyvern, Phoenix and East Collieburn seams yield 12-20 gallons of tar per ton at 600°C. Other seams of the Co-operative and Cardiff Horizons yield less than 10 gallons.

Horizon.	Tar.		Gas.	
	%	Gals/ton.	$\%CO_2$.	Therms/ton.
Griffin	6–10	12–20	25–30	11–20
Co-operative	2–3	4–7	30–40	10–14
Cardiff	4–5	9–10	40	13–14

* Some samples of Stockton range up to 1415°C.

TABLE 1.

FUEL LABORATORY SURVEY—1950 COLLIE COAL FIELD.

Proximate Analyses and Calorific Values.

Lab. No.	Fuel Survey No.	Position in Mine.	Analysis as Received.					Dry Ash Free.		Ash Dry Basis.	Sulphur.	Colour of Ash.
			H_2O. %	Ash. %	V.M. %	Fixed Carbon. %	Calorific Value. B.Th.U./lb.	V.M.	Calorific Value.	%		
6105/49	1	Black Diamond—Eastern End Top 6 ft. 3 in. coal	48·10	13·91	20·25	17·74	....	53·30	....	26·79	....	Pale Brown
6106/49	1	Black Diamond—Eastern End Bottom 12 ft. good coal	23·79	4·98	20·85	50·38	9,300	29·27	13,050	6·53	0·20	White
3095/50	16	Black Diamond—West End 9 ft. coal	19·40	5·40	21·80	53·40	10,080	29·00	13,410	6·70	0·24	White
7021/50	40	Black Diamond—S.E. Dip, 1½ in. smalls ex gantry	23·05	9·00	20·50	47·45	9,105	30·15	13,390	11·75	0·24	White
4263/50	17	Co-operative 9 Bord East Side Face	22·35	8·85	19·80	49·00	9,230	28·80	13,420	11·40	0·35	Buff
4264/50	17	Co-operative 9 Bord East Bottom	21·06	10·40	....	....	....	....	....	13·20	....	Buff
4265/50	17	Co-operative 9 Bord East Middle	22·65	7·25	....	....	....	....	....	9·38	....	Buff
4266/50	17	Co-operative 9 Bord East Stone Band	22·05	46·20	....	....	....	....	....	59·30	....	Buff
4267/50	17	Co-operative 9 Bord East Side Tops	21·95	8·45	....	....	....	....	....	10·80	....	Buff
4268/50	18	Co-operative 7 Bord East Side Face	20·75	10·75	20·15	48·35	9,210	29·44	13,440	13·55	0·32	Buff
4269/50	19	Co-operative 30 Bord East Side	20·35	8·50	21·15	50·00	9,600	29·75	13,500	10·70	0·28	Buff
6220/50	32	Co-operative East Side 40 Bord	19·10	8·40	22·50	50·00	9,730	31·00	13,420	10·40	0·32	Light Brown
6221/50	33	Co-operative East Side 30 Bord	20·25	8·35	22·00	49·40	9,495	30·75	13,280	10·45	0·27	Fawn
6222/50	34	Co-operative East Side 10 Bord	20·40	8·40	21·85	49·35	9,570	30·70	13,430	10·55	0·40	Fawn
6375/50	35	Co-operative West Side 23 Bord	18·00	6·05	22·95	53·00	10,280	30·25	13,540	7·40	0·19	Fawn
6376/50	36	Co-operative West Side 5 Right	21·70	6·15	22·80	49·35	9,650	31·60	13,360	7·85	0·29	Light Brown
4270/50	20	Proprietary No. 1 Sump heading 10 Left Face	24·30	7·20	20·90	47·60	9,050	30·55	13,200	9·50	0·33	Red Brown
4271/50	21	Proprietary No. 1 54 Bord 10 Left, Face	21·00	7·20	21·90	49·90	9,450	30·50	13,160	9·10	0·33	Red Brown
4272/50	22	Proprietary No. 1 Panel Heading 10 Left, Face	22·30	7·40	21·85	48·45	9,300	31·10	13,230	9·55	0·30	Red Brown
4273/50	23	Proprietary No. 1 16 Bord 10 Left, Face	21·90	6·30	20·80	51·00	9,550	29·00	13,310	8·20	0·43	Red Brown
4274/50	24	Stockton Open Cut 10 ft. off Bottom of Top Seam, No. 1 Seam	22·20	9·85 Mean Ash	22·20	45·75	8,530	32·65	12,540	12·70	0·37	Brick Red
4275/50	24	Stockton Open Cut 3 ft. off Tops of Top Seam No. 1 Seam	18·55	24·10 Mean Ash 13·70	19·60	37·75	6,955	34·15	12,190	29·60	0·40	Red-Brown
5373/50	28–1	Stockton Open Cut No. 1 Seam 3 in. Coal	24·75	2·80	....	....	....	....	....	3·75	....	Brick Red
5374/50	28–2	Stockton Open Cut No. 1 Seam 1 in. Batts	17·10	23·20	....	....	....	....	....	27·95	....	Light Brown
5375/50	28–3	Stockton Open Cut No. 1 Seam 4 ft. Coal	22·05	12·45	....	....	....	....	....	16·00	....	Brick Red
5376/50	28–4	Stockton Open Cut No. 1 Seam 3 ft. Coal	23·00	9·25	....	....	....	....	....	12·05	....	Brick Red
5377/50	28–5	Stockton Open Cut No. 1 Seam 1 ft. Batts	21·35	13·70	....	....	....	....	....	17·40	....	Brick Red
5378/50	28–6	Stockton Open Cut No. 1 Seam 2 ft. 6 in. Coal	22·00	12·20	....	....	....	....	....	15·65	....	Salmon
5366/50	25–1	Stockton 7 Rise Top 3 ft. 2 in.	27·10	7·20	21·75	43·95	8,340	33·10	12,705	9·90	....	Brick Red
5367/50	25–2	Stockton Middle 1 ft. of Batts	24·00	13·20	19·65	43·15	7,770	31·30	12,380	17·35	0·16	Brick Red
5368/50	25–3	Stockton Bottom 3 ft. 2 in. of Coal	26·45	9·35	22·25	41·95	8,160	34·65	12,705	12·75	0·35	Brick Red
5369/50	26–1	Stockton 5 Rise, 14 Bord 6 ft. of Coal	27·70	8·20	21·65	42·45	8,240	33·75	12,860	11·35	....	Brick Red
5370/50	26–2	Stockton 5 Rise, 14 Bord, 1 ft. Batts	25·50	13·35	19·75	41·40	7,660	32·35	12,525	17·92	0·25	Red Brown
5371/50	27–1	Stockton 1 Rise, 14a Bord 6 ft. Coal	24·10	6·95	22·40	46·55	8,860	32·45	12,850	9·15	0·63	Light Brown
5372/50	27–2	Stockton 1 Rise, 14a Bord 1 ft. Batts	23·40	10·50	20·85	45·25	8,415	31·55	12,725	13·70	....	Red Brown
5379/50	29	No. 2 Seam Stone Drive 14 Bord	25·40	5·75	21·10	47·75	9,070	30·85	13,190	7·70	0·35	Brick Red
5380/50	30	No. 2 Seam Stone Drive 1 Pannel Heading	24·00	6·20	21·55	48·25	9,050	30·90	12,965	8·15	0·27	Red-Brown
5381/50	31	No. 2 Seam Stone Drive Main Dip	22·60	6·00	21·35	50·05	9,315	30·30	13,045	7·75	0·40	Red-Brown
815/51	42	Stockton Open Cut No. 2 Seam	23·80	6·90	23·35	45·95	8,930	33·70	12,890	9·05	0·55	Red-Brown
67/50	2	Phoenix 5599 S.S.R. Top 15 in.	23·87	3·76	27·65	45·32	9,530	37·36	13,170	4·94	0·60	Red-Brown
68/50	3	Phoenix 5599 S.S.R. Bottom 3 ft. 9 in.	22·40	5·19	27·97	44·44	9,450	38·63	13,040	6·69	0·60	Red-Brown
69/50	4	Phoenix 5599 22 yds. L.	22·24	5·24	27·17	45·35	9,460	37·48	13,050	6·74	0·60	Red-Brown
70/50	5	Griffin Stone Drive 4 Bord	19·86	4·80	27·03	48·31	9,950	35·88	13,200	5·99	0·80	Red-Brown
71/50	6	Griffin Stone Drive 9 Bord	20·96	4·50	27·39	47·15	9,800	36·76	13,140	5·70	0·60	Red-Brown
72/50	7	Griffin Stone Drive 14 Bord	22·45	5·31	25·42	46·82	9,570	35·20	13,240	6·85	0·70	Red-Brown
1597/50	8	Wyvern No. 9 Left Gannon	20·55	3·00	29·55	46·90	10,140	38·65	13,250	3·75	0·40	Red-Brown
1598/50	9	Wyvern No. 7 Right	19·50	3·80	30·20	46·50	10,190	39·40	13,280	4·70	0·20	Brown
1599/50	10	Wyvern No. 6 Right	20·65	2·95	29·70	46·70	10,060	38·85	13,170	3·70	0·40	Light Brown
1600/50	11	Wyvern No. 7 Right Hard Coal	16·10	7·85	33·10	42·95	10,170	43·55	13,360	9·35	0·40	Red-Brown
7203/49	....	Wyvern Pillar Sample—Brasserts	20·25	3·66	30·52	45·57	10,130	40·10	13,310	4·59	....	Light Brown
1601/50	12	Griffin 22 Bord 10 Left Slants	21·95	3·40	27·75	46·90	9,800	37·15	13,130	4·35	0·30	Fawn
1602/50	13	Griffin 28 Bord	20·35	4·35	27·60	47·70	9,885	36·60	13,135	5·45	0·30	Brown
1603/50	14	Griffin 34 Bord	21·40	3·10	27·85	47·65	10,040	36·90	13,300	3·95	0·30	Brown

TABLE 1—*continued.*

FUEL LABORATORY SURVEY—1950 COLLIE COAL FIELD.

Proximate Analyses and Calorific Values.

Lab. No.	Fuel Survey No.	Position in Mine.	Analysis as Received.					Dry Ash Free.		Ash Dry Basis.	Sulphur.	Colour of Ash.
			H_2O. %	Ash. %	V.M. %	Fixed Carbon. %	Calorific Value. B.Th.U./lb.	V.M.	Calorific Value.	%		
7018/50	37	Wyvern Top Bord	21·55	3·25	29·50	45·70	9,975	39·30	13,260	4·15	0·50	....
7019/50	38	6 Left Section Bottom Bord	19·85	3·20	30·10	46·85	10,225	39·15	13,290	4·00	0·40	....
7020/50	39	Griffin New Heading West Barrier Bord	20·40	4·30	28·60	46·70	9,825	38·00	13,040	5·40	0·70	....
813/51	41–1	Collieburn Open Cut 7 ft. Coal below Stone Band	23·45	5·35	28·75	42·45	9,145	40·40	12,850	7·00	0·91	Grey
814/51	41–2	Collieburn Open Cut 1 ft. Coal above Stone Band	23·90	2·10	30·50	43·50	9,430	41·20	12,750	2·75	0·47	Grey
3085/50	....	Cardiff No. 1 Seam 2 Section 7 Loader 4 ft. of Tops and Batt	23·10	11·80	24·90	40·20	8,185	38·20	12,560	15·30	0·55	Buff
3086/50	....	Cardiff No. 1 Seam 2 Section 7 Loader 4 ft. of Tops less Batt	24·30	7·60	25·80	42·30	8,625	37·80	12,670	10·00	0·52	Buff
3087/50	....	Cardiff No. 1 Seam 2 Section 7 Loader 7 in. Batts 3 ft. down	15·90	35·70	....	....	5,600	....	....	42·50	....	Buff
3088/50	....	Cardiff No. 1 Seam 2 Section 7 Loader 6 in. Splint 6 in. Down	16·30	25·80	....	....	....	....	....	30·80	....	Buff
3089/50	....	Cardiff No. 1 Seam 35 Section 3 Loader 4 ft. Tops plus 5 in. Batts	23·90	12·10	22·70	41·30	7,890	35·40	12,320	15·80	0·52	Buff
3090/50	....	Cardiff No. 1 Seam 5 Section 4 Loader 3 ft. 6 in. Tops plus 2 in. Batts	23·80	10·00	25·00	41·20	8,345	37·80	12,610	13·20	0·56	Buff
3091/50	....	Cardiff No. 1 Seam 7 Section 7 Loader 3 ft. 6 in. Tops plus 2 in. Batts	23·80	8·30	25·10	42·80	8,635	37·00	12,710	10·90	0·57	Buff
3092/50	15	Cardiff No. 2 Left Side Tunnel 6 ft. Coal	24·20	5·50	26·80	43·50	8,869	38·10	12,630	7·30	....	Off White
3093/50	15	Cardiff No. 2 Left Side Tunnel 4 in. Splint	12·50 (A.D.)	12·40	28·30	46·80	....	37·80	....	14·20	....	White

TABLE 2.

FUEL LABORATORY SURVEY—COLLIE—1950 .

Low Temperature (600°C.) Carbonisation Assay (Gray King Apparatus).

Lab. No.	Mine.	Fuel Survey No.	Yield per Ton of Coal as Received.						Yield per 100 Grams.						Gas Analysis.						
			Char.	Liquor.	Tar.	Gas.			Char.	Liquor.		Tar.	Gas.		CO_2.	CnHm.	H_2.	CO.	C_2H_6.	CH_4.	N_2.
										Free.	Fixed.										
			Cwt.	Gals.	Gals.	Cu. ft.	C.V. B.Th.U. per c. ft.	Therms.	Gms.	Gms.	Gms.	Gms.	ml.	KCal/m_3							
6106/49	BD	1	12·2	50·2	5·1	2,465	439	10·8	60·8	20·0	2·4	2·3	6,870	4,190	36·4	1·0	12·9	22·5	4·0	23·2	0·0
3095/50	BD	16	12·6	60·2	6·8	2,445	569	14·0	62·8	20·0	6·9	2·9	6,810	5,435	26·8	2·0	12·3	23·9	11·4	20·6	2·9
7021/50	BD	40	12·3	65·4	3·8	2,525	482	12·2	61·7	23·0	6·2	1·7	7,045	4,600	30·7	2·0	19·0	16·9	3·8	25·3	2·4
4263/50	Co-op.	17	12·9	51·8	8·3	2,810	473	13·3	64·6	22·4	0·8	3·7	7,330	4,515	34·4	2·0	21·4	13·7	3·8	24·5	0·25
4265/50	Co-op.	17	12·6	57·3	7·9	2,830	478	13·5	62·8	22·7	2·9	3·6	7,880	4,560	33·5	1·8	21·2	13·5	4·1	25·1	0·8
4267/50	Co-op.	17	12·3	58·7	10·3	2,555	495	12·6	61·4	21·9	4·3	4·6	7,120	4,725	32·9	2·4	19·9	13·3	4·8	24·6	2·2
4268/50	Co-op.	18	13·2	51·2	7·2	2,600	432	11·2	65·8	20·7	2·1	3·2	7,250	4,120	37·8	2·0	19·2	14·4	3·5	21·5	0·6
4269/50	Co-op.	19	12·8	53·4	8·5	2,630	488	12·8	64·3	20·4	3·5	3·8	7,330	4,660	35·6	2·0	17·6	13·7	3·7	27·5	0·1
6220/50	Co-op.	32	12·9	52·0	6·4	3,190	429	13·7	64·3	19·1	4·1	2·9	8,900	4,100	34·4	1·7	20·9	13·2	2·4	23·6	3·8
6221/50	Co-op.	33	12·9	51·7	6·4	3,320	459	15·2	65·5	20·3	2·8	2·9	9,250	4,380	30·6	1·9	22·0	14·9	4·2	22·1	4·3
6222/50	Co-op.	34	13·0	52·2	6·8	2,975	538	16·0	64·8	20·4	2·9	3·0	8,290	5,135	33·5	1·9	21·5	13·7	3·5	21·8	3·8
6375/50	Co-op.	35	13·2	50·4	5·2	2,875	500	14·4	66·1	18·0	4·5	2·3	8,020	4,770	27·6	2·1	20·2	16·0	4·1	26·2	3·8
6376/50	Co-op.	36	12·2	59·4	7·7	3,195	485	15·5	60·9	22·1	4·4	3·4	8,910	4,630	29·5	1·6	21·9	13·6	3·4	27·3	2·8
4270/50	Prop.	20	12·2	58·4	8·5	2,895	401	11·6	61·0	24·3	1·8	3·8	8,070	3,825	40·8	1·8	20·6	11·9	2·7	20·6	1·6
4271/50	Prop.	21	12·9	52·8	7·1	2,775	399	11·1	64·5	21·0	2·6	3·2	7,730	3,810	43·4	1·7	19·4	11·0	3·2	20·4	0·8
4272/50	Prop.	22	12·8	53·7	7·2	2,935	385	11·3	64·1	22·3	1·7	3·2	8,190	3,675	43·2	1·7	19·8	11·6	2·7	19·6	1·6
5366/50	Stockton Mine No. 1 Seam	25·1*																			
5367/50	Stockton Mine No. 1 Seam	25·2																			
5368/50	Stockton Mine No. 1 Seam	26·1*	11·4	67·9	4·8	3,110	338	10·5	57·2	26·4	4·0	2·2	8,670	3,220	43·9	1·1	18·0	14·1	2·3	14·8	5·7
5370/50	Stockton Mine No. 1 Seam	26·2																			
5371/50	Stockton Mine No. 1 Seam	27·1*																			
5372/50	Stockton Mine No. 1 Seam	27·2																			
5379/50	Stockton No. 2 Seam	29*																			
5380/50	Stockton No. 2 Seam	30*	11·9	65·4	4·3	2,900	397	11·5	59·4	24·7	4·5	1·9	8,090	3,795	40·6	1·6	19·5	14·8	2·4	20·7	0·4
5381/50	Stockton No. 2 Seam	31*																			
815/51	Stockton Open Cut No. 2 Seam	42	11·8	71·1	6·1	2,810	409	11·5	59·0	23·8	8·2	2·7	7,840	3,905	38·2	1·8	20·5	13·2	(25·7)		0·5
67/50	Phoenix	2	11·1	67·3	14·5	2,825	551	15·6	55·4	23·9	6·2	6·5	7,880	5,260	26·5	2·3	18·8	11·7	5·8	29·5	5·4
68/50	Phoenix	3	10·9	65·4	14·1	3,450	546	18·8	54·7	22·4	6·8	6·3	9,630	5,210	26·7	2·0	20·4	13·4	5·0	30·0	2·3
69/50	Phoenix	4	11·0	66·3	11·7	3,545	573	20·3	55·1	22·2	7·4	5·2	9,890	5,470	26·9	2·3	21·2	14·7	7·9	26·4	0·6
70/50	Griffin	5	11·8	54·6	17·7	2,975	554	16·5	59·1	19·9	4·5	7·9	8,300	5,285	26·3	2·5	18·6	11·1	6·0	29·0	6·5
71/50	Griffin	6	11·5	60·7	14·3	3,180	548	17·4	57·6	21·0	6·1	6·4	8,870	5,230	27·4	2·5	21·6	13·6	5·9	27·0	1·9
72/50	Griffin	7	11·6	63·0	15·3	2,825	520	14·7	58·1	22·5	5·7	6·8	7,870	4,960	28·9	2·3	19·0	11·7	5·6	26·8	5·7
1597/50	Wyvern	8	10·9	61·2	17·1	3,725	594	22·1	54·3	20·6	6·8	7·6	10,380	5,670	22·4	2·3	17·1	16·6	4·9	34·3	2·3
1598/50	Wyvern	9	10·9	61·4	16·1	3,670	583	21·4	54·7	19·5	7·9	7·2	10,440	5,565	25·3	2·3	18·2	14·2	5·9	31·9	2·2
1599/50	Wyvern	10	10·8	62·5	17·5	3,745	560	21·0	54·0	20·7	7·2	7·8	10,430	5,345	24·5	1·9	18·0	17·0	5·2	31·0	2·4
1600/50	Wyvern	11	11·2	47·9	23·5	3,700	630	23·3	55·9	16·1	5·3	10·5	10,320	6,010	34·2	3·7	9·9	10·8	8·5	32·2	0·7
7203/49	Wyvern		10·8	55·9	19·3	3,400	623	21·2	54·3	20·0	5·0	8·6	9,480	5,950	22·0	3·0	18·6	14·3	6·8	32·6	2·7
1601/50	Wyvern	12	11·0	63·0	13·1	3,200	548	17·5	55·1	22·0	6·2	5·9	8,920	5,230	29·0	2·0	15·4	15·9	4·2	32·4	1·1
1602/50	Wyvern	13	11·4	59·3	9·7	3,345	512	17·2	57·1	20·3	6·1	4·3	9,320	4,885	30·5	1·8	15·4	15·6	2·5	32·4	1·8
1603/50	Wyvern	14	11·4	61·9	11·1	3,370	536	18·1	56·9	21·4	6·3	5·0	9,390	5,115	29·7	1·9	17·0	16·4	4·9	29·7	0·4
7018/50	Wyvern	37	10·8	64·5	14·6	3,535	529	18·7	54·1	21·5	7·3	6·5	9,860	5,045	27·5	2·5	17·8	16·3	5·1	27·0	3·9
7019/50	Wyvern	38	11·2	61·3	13·4	3,555	547	19·4	56·2	19·9	7·5	6·0	9,900	5,220	27·4	2·4	16·6	15·5	5·3	29·2	3·4
7020/50	Wyvern	39	11·3	59·2	14·3	3,655	517	18·9	56·6	20·4	6·0	6·4	10,190	4,935	29·3	2·3	19·8	13·6	5·0	26·5	3·5
813/51	Collieburn Open Cut	41·1	10·5	70·6	15·0	3,015	585	17·6	52·4	23·5	8·1	6·7	8,410	5,580	27·1	2·6	12·9	19·3	6·6	30·2	1·3
3091/50	Cardiff	*	11·2	67·0	9·4	2,990	449	13·5	55·8	24·0	5·9	4·2	8,330	4,280	39·7	2·0	14·1	16·0	3·2	24·6	0·4

TABLE 3.

Shallow Drilling, 1950.

Proximate Analyses and Calorific Values.

Lab. No.	Origin of Sample.	20 per cent. moisture Basis.					Dry Basis.	Dry Ash Free		Sulphur
		Moisture.	Ash.	Volatiles.	Fixed Carbon.	Cal. Value B.Th.U./lb.	Ash.	Volatiles.	Cal. Value B.Th.U./lb.	
2365	Lease 129 Borehole B5 East Collieburn G.S./C. 501 4ft. 0in. at 51 ft.	% 20·0	% 3·8	% 27·25	% 48·95	9,495	% 4·75	% 35·8	12,460	....
2366	Lease 129 Borehole B5 East Collieburn G.S/C 502 8 ft. 0 in. at 55ft.	20·0	5·85	27·35	46·8	9,305	7·35	36·9	12,250	....
3294	Borehole No. 7 East Collieburn G.S/C 48 ft. 5 in. 6 at 84 ft.	20·0	4·85	29·15	46·0	9,585	6·05	38·75	12,750	0·24
3295	Borehole No. 7 East Collieburn G.S/C 81 8 6 at 89½	20·0	11·35	25·90	42·75	8,625	14·2	37·75	12,570	0·33
3692	Borehole No. 8 East Collieburn G.S/C 86 5 0 at 81	20·0	2·40	30·0	47·6	9,830	3·0	38·7	12,660	0·24
3693	Borehole No. 8 East Collieburn G.S/C 89 8 0 at 86	20·0	5·6	27·8	46·6	9,335	7·0	37·35	12,540	0·20
3690	Borehole No. 9 East Collieburn G.S/C 46 5 0 at 81	20·0	2·65	28·95	48·40	9,805	3·35	37·45	12,670	0·24
3691	Borehole No. 9 East Collieburn G.S/C 304 8 0 at 86	20·0	3·5	28·5	48·0	9,630	4·40	37·25	12,590	0·21
4916	Borehole No. 15 East Collieburn G.S/C 334 5 6 at 69	20·0	2·9	29·5	47·6	9,320	3·6	38·25	12,100	0·25
4917	Borehole No. 15 East Collieburn G.S/C 333 7 6 at 73	20·0	2·95	28·65	48·40	8,975	3·7	37·2	11,650	0·29
4918	Borehole No. 13 East Collieburn G.S/C 311 5 0 at 64	20·0	2·6	28·2	49·2	9,695	3·25	36·45	12,520	0·25
4919	Borehole No. 13 East Collieburn G.S/C 314 8 0 at 69	20·0	3·2	29·25	47·55	9,480	4·0	38·1	12,345	0·29
6831	Borehole No. 20 East Collieburn G.S/C 33 4 6 at 46½	20·0	3·05	29·25	47·70	9,715	3·85	38·0	12,640	0·27
6832	Borehole No. 18 East Collieburn G.S/C 367 12 6 at 68½	20·0	2·75	29·40	47·85	9,680	3·45	38·05	12,525	0·22
6833	Borehole No. 19 East Collieburn G.S/C 320 4 0 at 37	20·0	2·55	28·95	48·50	9,605	3·2	37·4	12,410	0·24
6834	Borehole No. 19 East Collieburn G.S/C 323 7 0 at 41	20·0	4·55	28·65	46·80	9,470	5·7	38·0	12,560	0·44
6709	Borehole No. 16 East Collieburn G.S/C 344 10 6 at 99	20·0	3·6	29·2	47·2	9,580	4·5	38·25	12,540	0·25
6976	Borehole No. 20 East Collieburn G.S/C 314 4 0 at 51	20·0	2·95	30·05	47·0	9,690	3·7	39·0	12,580	0·20
6977	Borehole No. 21 East Collieburn G.S/C 328 4 0 at 41	20·0	6·35	28·50	45·15	8,610	7·95	38·65	11,695	0·16
6978	Borehole No. 21 East Collieburn G.S/C 401 9 0 at 45	20·0	4·85	29·30	45·85	9,490	6·05	39·0	12,570	0·20
7526	Borehole No. 26 East Collieburn G.S/C 4 4 6 at 59	20·0	3·75	26·40	49·85	10,100	4·7	34·65	13,250	0·37
7527	Borehole No. 26 East Collieburn G.S/C 9 4 6 at 63½	20·0	3·25	31·40	45·35	9,245	4·05	40·95	12,050	0·37
8546	Bore M.1 P.A. 55 and 56 G.S/C 33 4ft. 0 in. 66ft. 9 in.	20·0	14·0	25·85	40·15	8,315	17·5	39·25	12,600	0·82
8846	Bore No. 31 East Collieburn G.S/C 345 4 ft. 0in. at 113½ ft.	20·0	3·65	27·20	49·15	9,775	4·55	35·65	12,800	0·24
8847	Bore No. 31 East Collieburn G.S/C 342 9 ft. 6 in. at 117½ ft.	20·0	4·1	28·55	47·35	9,655	5·1	37·65	12.720	0·28

TABLE 4.

SHALLOW DRILLINGS, 1950.

(Carbonisation Assays).

Low Temperature (600°C.) Carbonisation Assay (Gray King Apparatus).

Lab. No.	G.S/C. No.	Yield per Ton of Coal as Received.						Yield per 100 Grams.						Gas Analysis.						
		Char.	Liquor.	Tar.	Gas.			Char.	Liquor.		Tar.	Gas.		CO_2.	CnHm.	H_2.	CO.	C_2H_6.	CH_4.	N_2.
					Cu. ft.	C.V. B.Th.U./ Cu. ft.	Therms.		Free.	Fixed.		ml.	KCal/m_3							
		Cwt.	Gals.	Gals.				Gms.			Gms.									
4916	334*																			
4917	333*	12·3	62·9	11·4	3,770	454	17·1	61·7	20·0	8·1	5·1	10,510	4,340	32·9	1·7	12·6	25·3	3·4	23·2	1·0
4918	311*																			
4919	314*																			
6831	33	11·2	62·1	11·8	3,570	510	18·2	56·2	20·0	7·7	5·3	9,950	4,870	30·7	2·9	12·6	23·2	4·2	25·0	1·5
6832	367	11·3	61·3	13·1	3,140	507	15·9	56·7	20·0	7·35	5·85	8,765	4,835	27·0	2·5	11·9	22·9	4·9	26·9	3·9
6833	320*	11·5	61·9	10·7	3,165	465	14·7	57·3	20·0	7·6	4·8	8,830	4,450	30·2	3·7	11·9	23·7	4·3	18·2	7·9
6834	323*																			
6709	344	11·2	62·5	12·0	3,515	467	16·4	55·9	20·0	7·9	5·4	9,795	4,460	31·1	2·5	11·1	24·7	3·8	22·3	4·5
6976	314	11·3	64·0	11·8	3,140	498	15·6	56·3	20·0	8·6	5·3	8,750	4,750	28·1	2·4	20·5	19·6	5·5	21·5	2·4
6977	328*	11·5	59·1	10·2	3,265	395	12·9	57·6	20·0	6·4	4·6	9,105	3,770	41·1	1·8	15·2	18·8	2·6	19·6	0·9
6978	401*																			
7526	4*	10·6	61·4	10·7	3,280	490	16·1	53·1	20·0	7·4	4·8	9,140	4,680	32·6	2·4	11·3	23·7	4·1	24·7	1·2
7527	9*																			
8546	33	11·6	59·8	11·1	3,105	494	15·3	58·2	20·0	6·7	5·0	8,660	4,710	37·8	2·6	14·1	14·7	3·9	26·7	0·2
8846	345*	11·2	61·8	13·0	3,370	506	17·0	55·9	20·0	7·6	5·8	9,400	4,830	28·3	2·5	12·8	25·0	3·9	25·5	2·1
8847	342*																			

TABLE 5.

Deep Drilling Samples, 1950—Proximate Analyses and Calorific Values.

Lab. No.	Origin of Sample.	20 per cent. Moisture Basis.					Dry Ash.	Dry Ash Free.		Ash Fusion Reducing Atmosphere			
		Moist.	Ash.	Volatile Matter.	Fixed Carbon.	Calorific Value B.Th.U./lb.		Volatile Matter.	Calorific Value B.Th.U./lb.	Softening, °C.	Blobbing. °C.	Fluid. °C.	Sulphur.
		%	%	%	%		%	%					
2367	Site "C" Lease 415 GS/C. 323 4 ft. 0 in. at 220 ft. 0 in.	20·0	5·05	29·20	45·75	9,560	6·3	38·95	12,760	1,320	1,360	1,400	·35
2368	Site "C" Lease 415 GS/C. 96 4 9 at 179 0	20·0	3·3	29·9	46·8	9,650	4·1	39·0	12,580	1,060	1,100	1,130	·37
2369	Site "C" Lease 415 GS/C. 324 7 0 at 238 0	20·0	5·6	28·4	46·0	9,265	7·0	38·15	12,460	1,060–1,085	1,130	1,180	·39
2685	Site "C" Lease 415 GS/C. 350 3 4 at 389 0	20·0	3·5	27·9	48·6	9,640	4·4	35·5	12,610	1,060	1,100	1,150	·56
2686	Site "C" Lease 415 GS/C. 315 3 10 at 397 0	20·0	2·9	29·65	47·45	9,765	3·6	38·4	12,660	1,125–1,165	1,230	1,320–1,350	·33
2687	Site "C" Lease 415 GS/C. 345 1 10 at 501½ 0	20·0	6·75	26·6	46·45	9,210	8·7	36·4	12,610	1,320	1,350	....	·46
3296	Site "C" Lease 415 GS/C. 321 4 9 at 692 0	20·0	7·4	26·8	45·8	9,245	9·25	36·95	12,740	....	....	....	·30
3297	Site "C" Lease 415 GS/C. 305 3 0 at 817 0	20·0	7·0	26·45	46·55	9,235	8·75	36·25	12,650	....	....	....	·49
3298	Site "C" Lease 415 GS/C. 327 2 6 at 820 0	20·0	17·85	24·75	37·40	7,790	22·3	39·85	12,530	....	....	....	·22
4087	Site "C" Lease 415 GS/C. 351 2 0 at 896 0	20·0	8·2	24·85	46·95	9,170	10·25	34·65	12,760	....	....	....	·46
4088	Site "C" Lease 415 GS/C. 84 4 4 at 1,251 3	20·0	12·6	23·75	43·65	8,535	15·75	35·25	12,660	....	....	....	·34
4089	Site "C" Lease 415 GS/C. 341 1 8 at 1,303 0	20·0	7·65	27·20	45·15	9,165	9·55	37·60	12,660	....	....	....	·60
4635	Site "C" Lease 415 GS/C. 72 3 4 at 1,477 0	20·0	10·6	23·95	45·45	8,750	13·25	34·5	12,600	....	....	....	·24
4636	Site "C" Lease 415 GS/C. 4 2 1 at 1,497 0	20·0	43·55	15·20	21·25	4,005	54·5	41·75	11,000	1,355	1,410	....	·13
4637	Site "C" Lease 415 GS/C. 9 2 6 at 1,499 0	20·0	13·2	22·35	44·45	8,435	16·5	33·45	12,620	....	....	....	·17
4638	Site "C" Lease 415 GS/C. 332 4 0 at 1,501½ 0	20·0	9·65	22·85	47·50	8,990	12·05	32·5	12,780	....	....	....	·27
4639	Site "C" Lease 415 GS/C. 301 3 0 at 1,505½ 0	20·0	7·9	24·1	48·0	9,285	9·85	33·4	12,885	....	....	....	·21
4640	Site "C" Lease 415 GS/C. 50 3 3 at 1,508½ 0	20·0	6·3	25·55	48·15	9,045	7·9	34·65	12,270	....	....	....	·25
4920	Site "C" Lease 415 GS/C. 22 2 2 at 1,565½ 0	20·0	7·6	25·3	47·1	9,500	9·5	34·90	13,120	....	....	....	·21
4921	Site "C" Lease 415 GS/C. 335 3 8 at 1,567½ 0	20·0	12·35	23·40	44·25	8,785	15·40	34·55	12,995	....	....	....	·20
4922	Site "C" Lease 415 GS/C. 331 1 1 at 1,569½ 0	20·0	7·25	26·35	46·40	9,485	9·05	36·20	13,040	....	....	....	·24
4923	Site "C" Lease 415 GS/C. 94 2 8 at 1,601½ 0	20·0	6·05	22·65	51·30	9,660	7·55	30·60	13,065	....	....	....	·21
4924	Site "C" Lease 415 GS/C. 342 3 0 at 1,604 0	20·0	5·75	25·25	49·00	9,745	7·2	34·0	13,125	....	....	....	·22
4925	Site "C" Lease 415 GS/C. 57 3 0 at 1,607 0	20·0	6·25	24·65	47·3	9,790	7·8	35·85	13,275	....	....	....	·30
6703	Site "L" Lease F 152 GS/L. 1 1 0 at 140 0	20·0	5·15	32·15	42·70	10,010	6·45	43·0	13,385	....	....	....	·81
6704	Site "L" Lease F 152 GS/L. 2 3 11 at 261 0	20·0	3·95	31·40	44·65	98,50	4·95	41·3	12,950	....	....	....	·64
6705	Site "L" Lease F 152 GS/L. 3 2 8 at 371½ 0	20·0	19·4	23·85	36·75	7,920	24·30	39·3	13,065	....	....	....	·35
6706	Site "L" Lease F 152 GS/L. 4 3 3 at 422 0	20·0	7·15	28·8	44·05	9,505	8·95	39·50	13,055	....	....	....	·41
6707	Site "L" Lease F 152 GS/L. 5 1 0 at 465 0	20·0	7·75	26·4	45·85	9,425	9·65	36·55	13,040	....	....	....	·47
6708	Site "L" Lease F 152 GS/L. 6 4 3 at 477 0	20·0	3·4	29·75	46·85	9,835	4·25	38·9	12,860	....	....	....	·41
6830	Site "L" Lease F 152 GS/L. 7 1 8 at 718 0	20·0	2·6	27·25	50·15	9,605	3·3	35·25	12,420	....	....	....	·32
6974	Site "L" Lease F 152 GS/L. 8 2 1 at 801 0	20·0	5·15	28·0	46·85	10,060	6·45	37·45	13,440	....	....	....	·34
6975	Site "L" Lease F 152 GS/L. 9 1 2 at 960½ 0	20·0	6·25	28·95	44·8	9,865	7·85	39·35	13,370	....	....	....	·34
8547	Site "E" Lease 328 GS/E. 2 2 9 at 138 3	20·0	12·15	20·25	47·60	8,815	15·2	29·85	12,990	....	....	....	·23
8548	Site "E" Lease 328 GS/E. 3 3 0 at 141 0	20·0	9·8	20·95	49·25	9,230	12·25	29·85	13,150	....	....	....	·31
8549	Site "E" Lease 328 GS/E. 4 3 10 at 144 0	20·0	10·7	20·75	48·55	9,000	13·35	29·95	12,990	....	....	....	·15
8550	Site "E" Lease 328 GS/E. 5 1 6 at 147 0	20·0	17·4	19·3	43·3	8,145	21·75	30·8	13,020	....	....	....	·19
8551	Site "E" Lease 328 GS/E. 6 1 9 at 149 7	20·0	23·45	22·2	34·35	7,100	29·3	39·25	12,550	....	....	....	·45
8552	Site "E" Lease 328 GS/E. 7 3 5 at 156 3	20·0	6·55	23·15	50·30	9,640	8·2	31·55	13,120	....	....	....	·24
8848	Site "E" (ML328) GS/E. 8 0 12 at 221 0 .... Drill Hole No. 3	20·0	10·05	23·70	46·25	9,350	12·55	33·9	13,370	....	....	....	·35

TABLE 6.

DEEP DRILLINGS, 1950.

Low Temperature (600°C.) Carbonisation Assay (Gray King Apparatus).

Lab. No.	G.S/C. No.	Yield per Ton of Coal as Received.						Yield per 100 Grams.						Gas Analysis.						
		Char.	Liquor.	Tar.	Gas.			Char.	Liquor.		Tar.	Gas.		CO_2.	CnHm.	H_2.	CO.	C_2H_6.	CH_4.	N_2.
					Cu. ft.	C.V. B.Th.U./ Cu. ft.	Therms.		Free.	Fixed.		ml.	KCal/ m_3							
		Cwt.	Gals.	Gals.				Gms.			Gms.									
2367/50	C323	11·1	62·7	13·4	3,415	486	16·6	55·7	20·0	8·0	6·0	9,520	4,635	34·2	2·2	13·5	19·8	3·9	25·6	0·8
2368/50	C96	11·0	63·2	12·6	3,445	458	15·8	54·8	20·0	8·2	5·7	9,610	4,375	38·1	2·5	13·7	17·3	4·0	22·8	1·6
2369/50	C324	11·3	60·6	8·7	3,655	410	15·0	56·6	20·0	7·1	3·9	10,190	3,920	43·0	1·8	16·6	13·9	3·3	21·0	0·4
3296/50	C321	12·4	60·5	10·9	2,925	508	14·9	61·9	20·0	7·0	4·9	8,106	4,845	31·4	2·6	13·3	22·9	4·7	24·6	0·5
4087/50	C351	11·9	58·4	8·5	3,170	431·5	13·7	59·6	20·0	6·1	3·8	8,830	4,120	41·0	1·9	17·9	14·6	4·3	19·7	2·2
4088/50	C84	12·2	59·3	6·0	2,940	408	12·0	60·8	20·0	6·5	2·7	9,170	3,900	40·4	1·8	16·8	13·7	2·5	22·0	2·7
4089/50	C341	11·7	60·0	11·3	2,785	492	13·7	58·6	20·0	6·8	5·1	7,760	4,700	36·5	2·9	12·8	17·2	3·5	26·3	0·9
4637/50	C9*																			
4638/50	C332*	12·5	56·7	5·2	2,860	343	9·8	62·4	20·0	5·4	2·3	7,970	3,275	49·3	1·6	16·8	12·6	2·8	16·1	1·1
4639/50	C301*																			
4640/50	C50*																			
4920/50	C22																			
4921/50	C335																			
4922/50	C331	12·5	47·8	10·9	3,550	390	13·8	62·5	20·0	1·3	4·9	9,900	3,720	36·8	1·9	18·0	13·3	1·3	21·9	6·9
4923/50	C94																			
4924/50	C342																			
4925/50	C57																			
6703/50	L1	10·6	58·0	26·6	3,030	632	19·1	53·0	20·0	5·9	11·9	8,425	6,030	27·1	3·6	16·6	12·6	6·7	33·1	....
6704/50	L2	11·0	66·3	14·3	3,055	566	17·3	55·2	20·0	9·6	6·4	8,510	5,400	27·2	3·1	11·4	16·3	6·0	29·6	6·2
6705/50	L3	12·4	60·3	13·6	2,345	533	12·5	62·2	20·0	6·9	6·1	6,535	5,085	32·6	3·0	18·1	13·3	4·8	24·4	3·8
6706/50	L4	11·5	59·9	14·8	3,260	573	18·7	57·4	20·0	6·7	6·6	9,085	5,470	28·1	2·6	18·9	14·3	6·8	28·2	1·1
6707/50	L5	11·9	58·9	11·2	3,185	513	16·3	59·7	20·0	6·3	5·0	8,875	4,900	32·2	2·3	18·8	11·5	2·4	31·6	0·9
6708/50	L6	11·3	59·2	16·9	3,225	576	18·5	56·7	20·0	6·4	7·5	8,990	5,495	26·3	2·6	15·0	11·4	4·9	29·0	11·0
6830/50	L7	11·9	57·7	13·9	2,810	496	13·9	59·6	20·0	5·8	6·2	7,830	4,740	35·0	2·3	13·3	12·6	4·7	27·4	4·5
6974/50	L8	11·6	58·8	15·7	2,910	535	15·6	58·2	20·0	6·2	7·0	8,120	5,110	27·3	2·6	18·8	14·2	6·5	25·1	5·3
6975/50	L9	11·5	58·9	18·1	2,940	571	16·8	57·3	20·0	6·3	8·1	8,190	5,450	23·2	1·3	19·1	14·7	7·0	31·2	3·4
8547/50	E2	12·8	57·5	5·0	2,650	397	10·5	64·0	20·0	5·7	2·2	7,395	3,785	37·7	1·6	22·4	12·6	1·4	22·2	2·3
8548/50	E3*																			
8549/50	E4*	12·7	55·8	6·0	2,825	414	11·7	63·7	20·0	4·9	2·7	7,880	3,950	38·5	1·6	23·5	9·7	3·1	21·4	2·2
8550/50	E5*																			
8551/50	E6*																			
8552/50	E7	11·7	57·2	9·4	2,820	464	13·1	58·6	20·0	5·5	4·2	7,865	4,430	27·4	2·2	20·1	15·8	4·0	22·5	8·1
8848/50	E8	12·0	58·1	12·8	3,080	530	16·3	60·2	20·0	5·9	5·7	8,600	5,060	25·0	2·9	22·4	17·1	4·4	25·5	2·7

Ash Fusion Points and Clinkering Behaviour of Collie Coals.

A considerable part of the year's work of the laboratory has been devoted to the matter of clinkering characteristics of Collie coals. Immediately following on this section are results of ash analyses, and ash fusion points together with a report on the Co-operative Seam East Headings (so called siderite coal) with associated observations on the use of this and other coals on locomotive boilers and chain grate stokers. The work has shown that though there are no badly clinkering coals at Collie some coals are much better than others in this matter.

On locomotive grates the high ash fusion point coals burn well no doubt because their ash is removed by constant vibration of the grate from the road. On chain grate stokers these coals are less acceptable because their ash lies unfused on the coal and thereby hinders combustion at the coal surface.

Low ash fusion point (1100°C) coals do not clinker on locomotive grates: some of the ash remains unfused and some is fused to a degree that it leaves the fire in the form of droplets which are found frozen in this form in the ash pan. These low ash fusion point coals do not cause any trouble on chain grate stokers.

Coals of intermediate ash fusion point (1250°C) appear to fall between the two extremes of behaviour: their ash fuses but not sufficiently to leave the grate in fluid form and therefore clinker accumulates in the fire. It should be added however that this simple explanation of the fact, that some coals of intermediate ash fusion clinker, may have to be modified in the future.

As a practical outcome of the work it has been found that admixtures of high and medium ash fusion point coals can be formulated to prevent clinkering where it is manifested. Coal from the Cardiff Mine is especially useful in this way.

Ash Analyses and Fusion Temperatures of Collie Coals from Collie Burn-Griffin Horizon.

Table 7 refers to the ash fusion temperatures and ash analyses of Collie coals from the Wyvern, Phoenix and Griffin Mines.

The ashes are all closely similar in characteristics. The ratio of silica to alumina is low and the proportions of iron oxide, lime and magnesia which act as fluxes in the ash are high as reflected in the effective silica figures worked out for each analysis. The ash fusion temperatures are correspondingly low and the ashes will undoubtedly show some clinkering tendency in practice which, however, can only give trouble in exceptional circumstances because the actual percentage ash associated with the coal is low; that is the ash itself has clinkering characteristics but the proportion of ash present in the coal is normally not sufficient to allow these characteristics to manifest themselves in any noticeable way. It is also thought that these coals have a low combustion zone temperature.

Coals of this type are exceptionally good fuels when used on chain grate stokers. Their high volatile matter (Ref. Table 1) gives a good radiant flame and the low ash fusion point gives a well burnt out clinker. We are indebted to Messrs. Colonial Sugar and Messrs. Swan Breweries for the opportunity to observe this coal in use on chain grate boilers.

Ash Analyses and Fusion Temperatures of Collie Coals from Co-operative and Cardiff Horizons.

Ash Fusions.

Table 8 refers to ash fusion temperatures of Collie coals from Proprietary, Co-operative, Stockton, Cardiff and Black Diamond Mines and an experimental shaft on the Ewington leases.

As an indication of clinkering tendency the fluid temperature under reducing atmospheric conditions, when the iron oxide of the ash is present in ferrous condition can be taken as a guide. Analytical determinations confirm that iron is normally present in coal ash clinker in ferrous condition, and it is usually considered that only coal ashes which are fluid below 1100°C or 2000°F in reducing conditions can give rise to dense clinker under normal conditions of operation. All the coals tested are above this limit. Clinker troubles with Collie coals are therefore improbable except under abnormal conditions of use and treatment.

Attention should also be directed to the high fusion point characteristics of the coals from the top three feet of the Stockton Open Cut No. 1 Seam, the Cardiff coals from both 1 and 2 seams, the Black Diamond Coal and the Ewington hard coal. The ashes of these coals will be difficult and in some cases impossible to fuse in the fire. For that reason clinker will in no case be formed, although under certain conditions a fire bed could become blanketed by an accumulation of fine unfused ash.

These high ash fusion characteristics may be of considerable merit in reducing slagging of refractory surfaces and consequent spalling and refractory failure. The possible saving in refractories which could result from the use of these coals is worthy of study by power station interests with a special reference to Black Diamond and Cardiff No. 2 Seam.

Ash Analyses.

Ash analyses of certain coals are also appended which bear out the general conclusions of the ash fusion temperature. Attention may be directed to the relationship of effective silica ratio to ash fluid temperature.

The low ash fusion point coals such as Proprietary, Co-operative and Stockton, show high proportions of iron oxide, lime and magnesia which act as fluxes. The coal from the Stockton seams also shows these characteristics but the batts from the Stockton No. 1 Seam Mine and the top three feet of the same No. 1 Seam in the Open Cut are lower in these fluxes and have higher ash fusion points. Coal from these seams may give unfused batt in the fire and therefore dirty fire conditions. This, of course, is normal for batt inclusions in coal.

Referring to the high ash fusion point coals, it is to be noted that the Cardiff coal is low in fluxing oxides. This also applies to the Black Diamond coal which further has the unusual characteristic of a high alumina to silica ratio of about 1:1 which is approximately the composition of kaolin and agrees well with the completely refractory character of the ash from this seam contrasting with the Cardiff where the ratio of alumina to silica corresponds to a less refractory composition.

There is included with the list of ash analyses one of a clinker from coke used on a carburetted watergas plant. Observations indicate that the ash fusion characteristics of this clinker suit the requirements of self clinkering grates on automatic carburetted watergas plants. If Collie coal were to be substituted for coke on such a plant the operation would be facilitated by selection of a Collie coal of similar ash fusion characteristics. Unfortunately, examination of the listed ash analyses and ash fusion points of all the coals available at Collie indicates that no Collie coal corresponds exactly with the New South Wales coal ash. There is, therefore, need for actual working tests to discover which particular Collie coal or mixture of Collie coals is best suited to operation of carburetted watergas plant.

A possible suggestion is that either Black Diamond or Cardiff coal admixed with one of the coals of lower ash fusion point would provide the characteristics required. But so far work has been confined to use of Black Diamond and Cardiff coals, separately which although of great value because they do not clinker, do however, hold back the blast on water gas plants. This point is pursued in a separate section dealing with use of Black Diamond coal on water gas plants.

Trials made with Co-operative coal on chain grate stokers show that this coal is well suited for firing by this method. Black Diamond coal is not because its nonfusible ash blankets the burning of the coal lumps; the rate of steaming is reduced and the dump ash contains much unburnt coal. Cardiff coal behaves in a similar but less marked manner. Blending of such coals with coals of lower ash fusion point produces an ash in which there is much nodulated coal overlaid and enclosed in the clinker of the more fusible coal.

TABLE 7.

ASH ANALYSES—WYVERN, PHOENIX AND GRIFFIN MINES.

Mine	Wyvern.	Phoenix.	Griffin.
Lab. No.	G.S.C. 19–20	67/50, 68/50, 69/50, F.L.S. 2, 3, 4.	70/50, 71/50, 72/50, F.L.S 5, 6, 7.
Details—			Stone Drive
Ash—Dry Basis	3·97%	6·12%	6·18%
Analysis—			
SiO_2	32·3	35·7	39·9
Fe_2O_3	26·6	20·4	23·4
Al_2O_3	23·3	27·4	22·2
TiO_2	1·0	1·4	1·0
CaO	5·7	5·9	4·9
MgO	2·3	1·8	2·0
Mn_3O_4	0·3	0·1	0·4
SO_3	7·9	6·5	6·0
P_2O_5	0·6	0·1	0·01
$Na_2O + K_2O$	....	0·7	0·2
	100·00	100·00	100·01
$\frac{SiO_2}{Al_2O_3}$	2·3 : 1	2·2 : 1	3·0 : 1
CaO + MgO	8·0	7·7	6·9
Effective SiO_2†	48·3	56·0	56·8
Ash Fusions—			
Reducing Atmosphere—			
Softening	....	*1183°C—2161°F	1070°C—1958°F
Blobbing	n.d.	1238°C—2260°F	1100°C—2012°F
Fluid	....	1268°C—2314°F	1135°C—2075°F

*Average of three constituents

† The Effective Silica figure is the ratio $\frac{\%\ SiO_2}{\%\ (SiO_2 + Fe_2O_3 + CaO + MgO)}$ and is indicative of clinkering characteristics; the lower the effective SiO_2 the greater the proneness to clinkering.

TABLE 8.

Ash Analyses and Ash Fusion Points.

Proprietary and Co-operative Mines.

Mine	Proprietary.		Co-operative.	
Lab. No.	....	....	....	4269/50
F.L.S. No.	G.S.C. 57·62 Inc.	G.S.C. 54·56 Inc.	G.S.C. Comp. of G.S.C. 22–41 Inc.	F.L.S. 19
Details	11 Left. Sect.	10 Left Sect.	West Side.	30 Bord East Side Face.
Ash: Dry Basis	8·41 per cent.	10·245	11·29 per cent.	10·70 per cent.
Analysis—				
SiO_2	44·9	36·4	50·0	47·4
Fe_2O_3	20·7	27·1	16·1	15·7
Al_2O_3	26·8	27·2	22·2	20·1
TiO_2	0·9	0·7	1·2	1·0
CaO	2·3	3·3	4·7	7·1
MgO	1·8	1·4	1·9	3·2
Mn_3O_4	0·4	0·7	0·2	0·2
SO_3	2·2	3·2	3·7	5·3
P_2O_3	0·08	0·06	....	....
$Na_2O + K_2O$	....	....	....	....
	100·08	100·06	100·0	100·0
$\frac{SiO_2}{Al_2O_3}$	2·9 : 1	2·3 : 1	3·8 : 1	4 : 1
CaO + MgO	4·1	4·7	6·6	10·3
Percentage Effective SiO_2 $\frac{\%SiO_2}{\%\ (SiO_2 + Fe_2O_3 + CaO + MgO)}$	64·5	53·4	68·8	64·6
Ash Fusion Temperatures.				
Reducing Atmosphere—				
Softening	1075°C–1967°F	1055°C–1931°F	1135°C–2075°F	1160°C–2120°F
Blobbing	1125°C–2057°F	1095°C–2003°F	1165°C–2129°F	1190°C–2174°F
Fluid	1195°C–2183°F	1130°C–2066°F	1180°C–2156°F	1200°C–2192°F
Oxidising Atmosphere—				
Softening	1280°C–2336°F	....	1280°C–2336°F	1160°C–2120°F
Blobbing	1340°C–2444°F	....	1300°C–2372°F	1200°C–2192°F
Fluid	1355°C–2471°F	....	1300°C–2372°F	1270°C–2318°F

The Effective Silica figure is the ratio $\frac{\%SiO_2}{\%\ (SiO_2 + Fe_2O_3 + CaO + MgO)}$ and is indicative of clinkering characteristics: the lower the effective SiO_2 the greater the proneness to clinkering.

TABLE 9.

Ash Analyses and Ash Fusion Points.

Stockton Mine.

Mine	Stockton No. 1 Seam.		Stockton No. 2 Seam.	Stockton No. 1 Seam Open Cut.
Lab. No.	Comp. of: 5367, 70, 72/50	5366, 68, 69, 71/50	5379, 80, 81/51	4275/50
F.L.S. No.	25–2, 26–2, 27–2	25–1, 25–3, 26–1, 27–1	29, 30, 31	24
Details	Composite sample of three bands of batts 1 ft. thick found in No. 1 Seam	Composite of coals 3 ft. coal bands in No. 1 Seam	....	Top 3ft. Open Cut
Ash: Dry Basis	16·32%	11·37%	7·87%	29·6%
Analysis—				
SiO_2	58·7	44·9	43·4	67·1
Fe_2O_3	15·2	26·5	26·7	8·1
Al_2O_3	19·7	22·1	20·8	21·4
TiO_2	1·1	1·2	1·3	1·7
CaO	2·1	2·2	2·0	0·7
MgO	1·2	1·3	1·7	0·6
Mn_3O_4	Trace	0·1	0·3	*Nil*
SO_3	1·1	1·5	2·8	0·4
P_2O_5	....	....	....	....
$Na_2O + K_2O$	....	....	....	....
	99·1	99·8	99·0	100·0
$\frac{SiO_2}{Al_2O_3}$	5·1 : 1	3·4 : 1	3·5 : 1	5·3 : 1
$CaO + MgO$	3·3	3·5	3·7	1·3
Percentage Effective SiO_2 $\frac{\%\ SiO_2}{\%\ (SiO_2 + Fe_2O_3 + CaO + MgO)}$ —	76·1	60·0	58·8	87·7
	Ash Fusion Temperatures.			
Reducing Atmosphere—				
Softening	1195°C–2183°F	*1120°C–2048°F	1120°C–2048°F	1380°C–2516°F
Blobbing	1235°C–2255°F	1155°C–2111°F	1165°C–2129°F	1415°C–2579°F
Fluid	1320°C–2408°F	1205°C–2201°F	1205°C–2201°F	1460°C–2660°F
Oxidising Atmosphere—				
Softening	....	1295°C–2363°F	1295°C–2363°F	....
Blobbing	....	1350°C–2462°F	1340°C–2444°F	....
Fluid	....	1370°C–2498°F	1370°C–2498°F	....

The Effective Silica figure is the ratio $\frac{\%\ SiO_2}{\%\ (SiO_2 + Fe_2O_3 + CaO + MgO)}$ and is indicative of clinkering characteristics: the lower the effective SiO_2 the greater the proneness to clinkering.

*Ash Fusion done on Coal and Batts.

TABLE 10.

Ash Analyses and Ash Fusion Points.

Cardiff, Black Diamond Mines and New South Wales Gas Coal.

Mine	Cardiff No. 1 Seam.		Black Diamond.	New South Wales Gas Coal.
Lab. No.	3089–3091/50	3087/50	6106/49	....
F.L.S. No.	....	....	F.L.S. 1	....
Details	No. 1 Seam Top 4 ft. Coal.	No. 1 Seam Top 4 ft. Batts.	West End of Cut 19–10–49	Ex Gas Works Carburetted Water Gas Plant.
Ash: Dry Basis	13·3%	42·5%	6·53%	....
Analysis—				
SiO_2	63·1	79·3	47·2	46·8
Fe_2O_3	6·3	1·9	4·5	12·7
Al_2O_3	23·3	16·6	47·4	30·7
TiO_2	1·0	1·1	....	1·4
CaO	0·8	0·3	*Nil*	3·9
MgO	1·2	0·4	0·6	1·7
Mn_3O_4	*Nil*	*Nil*	*Nil*	Trace
SO_3	1·7	0·4	0·3	0·4
P_2O_5	....	....	....	....
$Na_2O + K_2O$	(Fluorine Present)	....	....	....
	97·4	100·0	100·0	97·6
$\frac{SiO_2}{Al_2O_3}$	4·6 : 1	8·3 : 1	1·7 : 1	2·6 : 1
CaO + MgO	2·0	0·7	0·6	5·6
Percentage Effective SiO_2 $\frac{\%\ SiO_2}{\%\ (SiO_2 + Fe_2O_3 + CaO + MgO)}$	88·3	96·9	90·3	71·9
	Ash Fusion Temperatures.			
Reducing Atmosphere—				
Softening	*Approximately 1340°C–2444°F	n.d.	1600°C–2912°F	1225°C–2237°F
Blobbing	1480°C–2696°F	n.d.	....	1320°C–2408°F
Fluid	....	n.d.	....	1401°C–2570°F
Oxidising Atmosphere—				
Softening	n.d.	n.d.	....	1380°C–2516°F
Blobbing	n.d.	n.d.	....	1420°C–2588°F
Fluid	n.d.	n.d.	....	1485°C–2705°F

* Ash fusion done on 3090/50.

The Effective Silica figure is the ratio $\frac{\%\ SiO_2}{\%\ (SiO_2 + Fe_2O_3 + CaO + MgO)}$ and is indicative of clinkering characteristics; the lower the effective SiO_2 the greater the proneness to clinkering.

Black Diamond Coal for Carburetted Water Gas Manufacture at Fremantle.

Coal from the Black Diamond Open Cut has been in use on the Carburetted Water Gas Plant of the Fremantle Gas Company since the beginning of November in place of Proprietary coal formerly used. The Fremantle Gas Company is satisfied the change is giving improved working results and expect to continue to use Black Diamond by preference so long as the present good standard of delivery holds.

The change has been made on our recommendation. The successful results obtained suggest that at the present time a considerable part of the towns gas requirements of Western Australia can be provided more cheaply and freely by gasification of Black Diamond and coals of similar character from the Collie field than from the relatively restricted and high priced supplies of Eastern States coal at present imported.

Whether long term gas making policy can be based on water gas production from Collie coal is a different matter. The known resources of coal of the Black Diamond type will suffice for a limited number of years. The geological survey of the Collie field may prove more extensive supplies. Otherwise gas production based on water gas manufacture can only be regarded as an interim measure pending the adoption of the Lurgi Process.

Our own good opinion of Black Diamond coal which lead us to recommend it to the Fremantle Gas Company is based on routine examination of the coal made during the course of our survey of the Collie Field. It was noted that the Black Diamond coal had an ash which for all practical purposes is infusible. Such an ash would give no clinker trouble in any application including water gas plants which, because their fuel bed operates at a high temperature, are prone to clinker trouble.

A further property of the Black Diamond coal is an unusual one confined to a limited number of coals at Collie which again appears to be associated with ash composition and which enables such coals to burn with high fuel bed temperatures necessary for carburetted water gas manufacture. As between Proprietary and Black Diamond coals this means that less fuel has to be burnt to keep the fuel bed at gas making temperatures when using Black Diamond coal and gas production is from every point of view more satisfactory. In consequence a plant should use less coal when operating with Black Diamond coal.

The prediction as regards clinkering has been fully substantiated at Fremantle. Formerly the plant had to be shut down for clinkering once every eight hours and the removal of clinker was a fairly arduous task involving the cutting away of clinker from the refractory brick lining of the plant. The brickwork inevitably suffers wear and damage in this operation. With Black Diamond the periods between fire cleanings was extended to twelve hours, the unfused ash had only to be raked out and there was no adhesion or damage to brickwork. If a rocker type grate were fitted to the plant there would be no need to stop the plant for cleaning except for periodic removal of batts at daily or longer intervals.

As a consequence of the ease of firecleaning the fuel loss in the ash removal was only 4.1% of the fuel charged. As the plant was more easily clinkered at longer intervals, the time that both the plant and operators were usefully employed in gas making was increased.

There is one drawback associated with the use of Black Diamond coal. The finely divided, unclinkered ash raises the resistance of the fuel bed to the passage of air in the blow. In consequence the air rate is reduced to 1,300-1,600cfm. as compared with 2,000cfm. maintained with coke and Proprietary coal—Proprietary is a clinkering coal. The rate at which a water gas plant can make gas is controlled by the air rate and volume during the blow. In consequence the rate of gas making is lower for Black Diamond than for Proprietary coal—17,000 as against 19,000 cft./hr.

On larger sets equipped with waste heat boilers it would be possible to restore conditions by increasing the length of the blow. The Fremantle set however has no boiler and the excess of blow gas produced in a lower blow would have to be burnt in the stack since it cannot be burnt in the carburetter without raising carburetter temperature above the optimum required for oil-cracking. More heat could be used only by increasing the load on carburetter by increased oil cracking to produce a higher calorific value gas. In the instance of Black Diamond coal the oil requirements are less than with other fuels, not greater, so that the blow has to be reduced in period.

Obviously to develop the full potentialities of Black Diamond coal test should be made on plant fitted with a waste heat boiler. A plant of this type exists on the State Gasworks but access to it is not permitted.

Figures are set out below for comparative blow gas analyses and rates of gas making and more comprehensive figures are given in Table 1.

Blow Gas Analyses.

(High CO_2 and low CO indicate efficient operation.)

Coal.	Black Diamond.	Proprietary.	Coke.
CO_2	13·4	10·4	13·0
H_2	6·6	7·6	4·0
CO	12·0	16·7	15·0
N_2	68·0	65·3	68·0
Rate of Gasmaking c. ft/hr.	17,300	19,000	22,400

A factor which has emerged from the trials is the presence of about 3.0% of methane in the blue water gas made. Methane is present not only in the uprun gases where its presence can be expected, but also in the back run gas where it should not normally occur. It has been confirmed both by gas analysis and calorimetric determination. Methane is of value as it enables the amount of gas oil used in enrichment to be reduced by 5% and gasmaking costs by an associated 2.0%. It is thought that the presence of this percentage of methane is also related to the ash properties of Black Diamond, and this is matter which it will be of interest to develop. The figures for gas analyses and the main gas production results are in Table II.

In conclusion the opinion is expressed that in coal of that character of Black Diamond the State possesses unique assets and endeavour should therefore be made to utilise them to overcome the present critical state associated with the use of Newcastle coal for gas supplies in the Metropolitan area.

Our thanks have also again to be tendered to Mr. Leonard and Mr. Taylor and the staff of the Fremantle Gas Company for their valuable help and co-operation in the above work. Working trials on full scale plant are essential to the work of the Fuel Laboratory and without the enterprise shown by Fremantle in this matter the rapid development of thought on the potentialities of the Collie field which has taken place during the past 18 months could not, perhaps, have occurred. Our most cordial thanks should be tendered.

Table 11.

BLACK DIAMOND COAL.

Comparative Gas Making Results.

	Black Diamond	Proprietary.	Coke.
Period of test, hours	70·59	17·75	5·25
C.W.G. made, cu. ft.	1,200,100	337,900	119,800
C.W.G. made, cu. ft. per hr.	17,300	19,000	22,400
Weight of coal gasified, lb.	48,760	12,750	4,200
Oil consumption, galls.	2,755·9	820·5	260·4
Number of cycles	11,224	284	100
Duration of cycle	3′ 45″	3′ 45″	3′ 8″
C.V. of gas, B.Th.U./cu. ft.	533	532	511
Ash and Fliers, lb./100 lb.	9·6	4·83	12·05
C.W.G. cu. ft./ton of fuel	55,000	59,400	63,900
B.W.G. cu. ft./ton of fuel	46,200	47,400	53,500
Fuel, lb./1000 cu. ft. of C.W.G.	40·72	37·8	35·0
Fuel, lb./1,000 cu. ft. of B.W.G.	48·5	47·4	41·9
Oil, galls./1,000 cu. ft. C.W.G.	2·30	2·45	2·17
Therms/gall. of oil	1·30	1·32	1·4
C.V. of B.W.G. B.Th.U./cu. ft.	280	262	252
Therms of B.W.G./1,000 lb. of fuel	57·75	55·6	60·2
B.W.G. Efficiency = ...	55·0%	57·8	59·5
Analysis of Coal—			
Moisture	17·2%	20·6	16·00
Ash	6·4	7·17	11·95
V.M.	22·6	21·73	3·18
Calorific Value	10,500	9,620	10,140
Analysis of Clinker—			
Ash	76·2%	56·48	90·57
Analysis of Fliers—			
Ash	42·6%	30·09	13·9

Black Diamond results are more reliable as seen for longer test periods. Therefore levelling up of fires, etc., is of less moment.

	C.W.G. Finished Gas.	B.W.G. Uprun.	B.W.G. Back run.	Blow Gas.
	%	%	%	%
CO_2	7·52	6·49	8·23	13·4
O_2	0·40	0·0	0·0	....
CnHm	9·26	0·69	0·0	....
H_2	37·43	46·13	56·2	6·6
CO	22·99	31·84	31·08	12·0
C_2H_6	1·12	0·0	0·15	...
CH_4	11·99	4·23	1·78	...
N_2	9·29	10·63	2·54	68·0
Undecomposed steam	....	63·8	68·3	....

PROPRIETARY COAL.

	C.W.G. Finished Gas.	B.W.G. Uprun.	B.W.G. Back run.	Blow Gas.
	%	%	%	%
CO_2	7·8	6·0	13·4	10·4
CnHm	9·1	0·1	....	....
H_2	39·2	45·4	61·4	7·6
CO	22·2	39·0	24·0	16·7
C_2H_6	1·2	0·8	....	....
CH_4	11·1	2·3	....	....
N_2	9·4	7·4	1·8	65·3
Undecomposed steam	....	48·3	58·3	....

COKE.

	C.W.G. Finished Gas.	B.W.G. Uprun.	B.W.G. Back run.	Blow Gas.
	%	%	%	%
CO_2	6·2	5·1	10·0	13·0
CnHm	8·3	....	....	....
H_2	38·3	52·0	55·0	4·0
CO	27·8	40·0	35·0	15·0
C_2H_6	2·2	....	....	....
CH_4	5·4	....	....	....
N_2	11·4	2·9	....	68·0
Undecomposed steam	....	27·0	61·0	....

CYCLES OPERATED.

	Black Diamond.		Proprietary.		Coke.	
	Secs.	%	Secs.	%	Secs.	%
Time of Blow	63·5	28	67	30	68	36
Time of Run	98	44	108	48	80	42·5
Time of Back Run	63·5	28	50	22	40	21·5
Total Time	225	....	225	....	188	....

APPENDIX 1.

REPORT ON AN INVESTIGATION OF COAL FROM THE CO-OPERATIVE EAST HEADING COLLIE.

Summary.

"The Co-operative East Heading" is the designation of a 14 foot seam of excellent hard coal of good calorific value and conspicuous steaming quality found in one part of the Co-operative Mine area. It is to be regarded as one of the most valuable seams in the Collie basin.

This coal has, in the past, been termed "siderite" coal. The amount of siderite in the coal is not more than 1.0% by weight and is too small a quantity to influence either the behaviour of the coal or its ash and the clinker formed from it. Other Collie coals contain identical siderite inclusions of a similar harmless nature. The term "siderite" therefore characterises neither the Co-operative East Heading nor the behaviour of the coal it contains. Therefore, the application of the descriptive adjectives "siderite" or "sideritic" to the Co-operative East Coal could valuably be discontinued.

The coal is a good hard coal of good calorific value and possesses excellent steaming qualities. This has been demonstarted in a number of locomotive trials. Its ash content is 2% to 3% higher than for other Co-operative coals and therefore ash and clinker accumulations in the firebox are greater than from some other Collie coals—perhaps 30% greater. This feature causes comment when the firebox is cleaned although, as the ash is formed into a light manageable clinker of a favourable kind whiih is easily broken up and removed, such comment, if unfavourable, is not justified.

Slag accumulations from the coal are reported at one power station, especially at periods of low load. The trouble is associated with the higher (not lower as is thought by some) ash fusion point of the coal compared with other coals used and should be amenable to control by adjustment for low load conditions.

In any case trouble in larger and more modern power stations would not be expected because improvements in design eliminate slag prone areas.

An adequate reason has not been found in the course of this investigation for the unfortunate reputation which the Co-operative East Side Coal acquired when it was first worked in 1930-1931. It is, however, not impossible for variations especially in mineral content of the composition of a coal to occur between one part of a seam and another. It is then possible, that the characteristics of the coal in 1930-31 were different from those of the present working places. This and all other working places at Collie are now sampled and analysed at regular intervals so that if any relapse in quality of the Co-operative seam occurs it would be noted and users can be suitably advised.

It is doubtful if the Co-operative East Side coal is distinct from the older or West Side of the Co-operative Mine. Coal from both parts of the mine is referred to in this report and it will be clear from the context which coal is designated.

Introduction.

The term "siderite coal" has been given in the past to coal from the Co-operative East Heading because this coal contains iron carbonate (siderite) in the form of thin veins or laminae approximately 1/16" in thickness lying in a plane inclined at 45° to the bedding plane of the coal. Users of this coal have suggested that the iron oxide which the siderite contributes to the ash content of the coal may act as a flux and cause a reduction in ash fusion point and an increase in slag and clinker troubles.

These views appear to be incorrect. Siderite is not unique to the Co-operative East Heading nor is the amount present in this or any other known seam of the Collie field sufficient to influence the behaviour of the coal or the properties of its ash.

In the course of the Fuel Laboratory Survey of the Collie field the general occurrence of laminated iron mineral inclusions in most coal seams has been noted. Examination, indentification and evaluation of these inclusions leads to the view that users have made an incorrect diagnosis in ascribing any troubles which they experience with the Co-operative coal to siderite. The further opinion has been formed that the coal is in no way exceptional and should give no trouble in use. Difficulties which have been reported have, however, some foundation in fact. Any unfavourable comment passed when used on locomotives appears to rest on an ash content 2% to 3% higher than is accepted as normal for Co-operative Coals. Difficulties with slagging at Collie Power Station at periods of low load are associated with ash fusion points perhaps 50°C (100°F) higher than is normal for Co-operative and 100°C (200°F) higher than is normal for Proprietary coal. Neither of these variations in ash characteristics call for other than slight variation in operation technique when the coal is in use.

Iron Mineral Inclusions in Collie Coal.

Findings on the occurrence of iron mineral inclusions in Collie Coal are set out in Table 12.

TABLE 12.

OCCURRENCE OF IRON MINERAL INCLUSIONS IN COLLIE COAL.

Mine.	Nature of Inclusion.
Co-operative East Side	Siderite and Mixed Siderite and Pyrite.
Proprietary No. 1 Panel Heading	Siderite, Pyrite and Marcasite.
Stockton No. 1 Seam Open Cut	Veins of Pyrite with Marcasite and masses of Siderite.
Stockton No. 2 Seam	Siderite laminae with Marcasite, Pyrite and Epsomite.
Cardiff No. 1 Seam	Marcasite with Pyrite and Melanterite.
Cardiff No. 2 Seam	As No. 1 Seam.
Wyvern 7 Right Heading No. 2 Bord	As No. 1 Seam.
Black Diamond	Marcasite partly altered to Melanterite.
	Pyrite and Marcasite are iron sulphides. Melanterite is iron sulphate. Siderite is iron Carbonate.

The position may be summarised:—

(1) Siderite occurs in coal seams other than those of the Co-operative East Heading, e.g., the neighbouring Proprietary. Comment of users on Proprietary coal is normally favourable.

(2) Inclusions of mineral iron compounds such as iron sulphide (as marcasite and pyrites) or iron sulphate (as melanterite) in form similar to those of the Co-operative Seam occur in practically all the seams worked at Collie. These minerals will contribute iron oxide to the ashes of the coals in which they occur in exactly the same way as siderite is said to do. It is very probable that some of these inclusions could be converted into siderite by natural processes. None of these other coals attracts the same adverse comment as does Co-operative East Coal.

(3) The amounts of iron oxide contributed to the ash of any Collie coal by siderite or by any other iron mineral inclusion are so slight that they can have no bearing on the fluxing of the coal ash. Thus the siderite present in the Co-operative East Side coal is less than 1.0% by weight of the coal and contributes only 1 % to the 16% of iron oxide present in the ash from the coal. Refer to Tables 13 and 14 on mineral and ash analysis of coals.

Co-operative Coal in Use.

Evidently the diagnosis that Co-operative East Side coal is troublesome because it contains siderite, is erroneous. It is, however, not unknown for the wrong diagnosis to be made of a real complaint.

When examining users' complaints, especially of coal, it is general principle to ask in the first place if the complaint is made because the fuel or coal is really bad or if it is made because the coal is "different" from that which the consumer is used to. Differences in fuels can cause trouble in use.

The complaint about the Co-operative East Coal is that it has a fusible ash which forms a bad clinker. In the past it is said to have caused sever clinkering of railway locomotives. In use at one power station it has been reported as causing heavy slagging of refractory walls, particularly at periods of light load. The opinion has been formed that both these complaints are occasioned by slight differences between the ash of Co-operative East Coal and other Co-operative and Proprietary coals.

Ash Analysis.

Examination of the coal in respect of analysis and ash characteristics shows that the coal is a good average Collie coal, physically hard and well suited for locomotive use and of the normal high calorific value of Co-operative coals (about 9,500 B.T.U./lb.). The ash content in the range of 9%-12%, is higher than other Co-operative coal, but it is not so high as to give this coal the character of a poor or dirty coal; in fact, it appears that the higher ash content is offset and compensated for by a higher calorific value.

The ash itself possesses good characteristics. It is specifically not high, but low in iron oxide content. The other possible fluxing agents—lime and magnesia—are higher than in other coals by a few per cent., but not high enough to be troublesome.

An approximate index which serves as a guide to the trouble to be anticipated with the clinker from any coal is the percentage Effective Silica defined as:—

$$\frac{\text{Silica} \times 100}{\text{Silica} + \text{Iron Oxide} + \text{Lime} + \text{Magnesia}}$$

The higher this index for any ash the easier it is to handle the clinker formed by the ash. The index for Co-operative East Side Ash is 65 which is high.

Ash Fusion Points.

Measurements of the ash fusion points of Co-operative coals bear out the predictions made from the ash analysis that the ash fusion point is moderately high. The range of fusion of standard test comes in from a temperature of 1160°C (2120°F) for incipient softening to 1200°C (2192°F) for complete fluidity. It is usually accepted as a working guide that coal ashes which are not fluid below 1100°C (2112°F) are unlikely to form troublesome clinker.

In Table 14 on the following page are given characteristic ash fusion temperatures of Collie coal ashes in reducing and oxidising conditions. The reducing atmosphere figure is usually taken as the guide to clinkering propensities. It is considered that reducing conditions prevail in an ash bed. Under reducing conditions the iron is present as ferrous oxide in which form its fluxing propensities are at their greatest.

A point of interest to note in Table 14 is the low ash fusion range of Proprietary coal, which comes much nearer to a characteristically bad clinkering coal than does Co-operative East Side. The ash fusion points of Cardiff and Black Diamond coal are by contrast too high for clinker formation and these two latter coals might burn with a dirty, ash blanketed, fire.

Locomotive Trials.

The evidence accumulated from some half dozen locomotive trials with Co-operative East Side coal is that the coal steams well, but forms larger quantities of ash and clinker than firemen and fire cleaners associate with coal of such good qualities. On all occasions the clinker formed has been easy to break up and remove from the firebox.

This behaviour is precisely what would be predicted from the analysis of the coal. The physical strength and high calorific value of the coals account for the good steaming properties. The extra 2%-4% of ash which the coal contains results in the higher ash accumulations. Thus comparisons of analyses of this coal and of Proprietary coal indicate that the ash accumulating in a firebox for similar coal consumption will be about 30% greater from the Co-operative coal.

Use in Major Power Stations.

If the Co-operative East Side is worked on an adequate scale the small coal produced would normally be used as pulverised fuel by power stations. No difficulty should be encountered at

either East Perth or Fremantle in using this coal: Neither in point of view of ash content nor of ash fusion point does it present any characteristics adverse to its use as pulverised fuel: because of its high calorific yalue it should upgrade the average of the calorific value of the mixture of coals normally used by the power stations.

In support of this opinion reference can be made to a recent article published in the Journal of the Institute of Fuel for April, 1950, Vol. 57, by Dr. J. A. Cooper and Mr. L. W. Young of the Imperial Chemicals Company, Billingham, on the performance of pulverised fuel boilers of the same make and type as those installed at East Perth and South Fremantle. The fuel used was a coal averaging 13.0%-14.5% ash content and possessing ash fusion points ranging from 1150°C to over 1450°C. The working experience with these coals over a period of 20 years was reported. Fuel efficiencies were satisfactory and the periods run between overhauls are quoted as being up to 100 days. In the course of operation modifications have been made to the boilers to bring them up to the present standard of the modern types installed in the Sate. The authors of this paper also say that slagging of the front walls of a pulverised fuel boiler is a normal occurrence which can be kept under control by proper attention to burner control and fuel size. This opinion is valuable as front wall slagging has in the past been troublesome at East Perth and it may be feared that a recrudance of such trouble would be associated with the use of Co-operative East Side coal.

Collie Power Station.

It has been suggested that difficulties are encountered when Co-operative East Side coal has been used at one older power station. Specifically slag builds up on the back and side walls of the boiler. These are of refractory brick situated behind a thin screen of boiler tubes spaced at about 15" intervals.

Similar troubles should not occur in modern stations where the boiler walls are more completely screened by boiler tubes and refractory brickwork to which slag will adhere is exposed less extensively. Findings and experience in this respect with Co-operative coal at the above older station are, therefore, not applicable to firing the same coal in modern power houses and difficulties formerly experienced would not be repeated on such larger and more modern power stations.

The Institute of Fuel article referred to bears on this particular slagging difficulty. When the Billingham boilers were installed in 1930 they had the same incomplete screening of back and side walls as the Collie boilers and slagging was in consequence experienced. These exposed areas were subsequently screened to prevent slagging.

Proprietary Coal at Collie.

In the absence of screening of back and side walls slagging can however be controlled. This is effected at Collie by using Proprietary coal on the boilers in preference to Co-operative. The reason given for this choice is that the ash from Proprietary coal fluxes less easily than that from Co-operative. This explanation is, however, not correct as it is the Co-operative ash which fluxes less easily, that is, fluxes at a higher temperature than that of Proprietary. It is, therefore, inferred that the success with firing Proprietary coal is associated with the greater ease of fluxing of the ash which reaches a degree of fluidity sufficient to enable any slag which forms on refractory walls to run off.

It can then be further surmised that difficulties with Co-operative coal are associated with inability to run or drip off refractory surfaces because of its high ash fushion point. This behaviour will be most apparent when boiler temperatures are low as would occur when the boiler loading is low. This concurs with experience at Collie that the build up of slag when Co-operative coal is in use is greater at week-end periods of low load. It is possible that the drop in furnace temperature associated with low load conditions could be offset by attention to the balance of air to fuel supply.

A further fact which emerges from consideration of Ash Fusion points in Table 15 is that there is not sufficient disparity between ash fusion points of Co-operative coal from older workings and that from the East Heading to explain why Co-operative coal was used successfully at Collie in the past and yet cannot be used at the present time. It is difficult to find a reason based solely on ash fusion points. The alternative reasons are (1) a 2%-3% higher ash content, (2) an increase of 5% in the alkaline earth content of the ash; or (3) some variation in control factor at the power station. It is this last which seems the most probable and valuable to investigate

TABLE 13.

CO-OPERATIVE EAST SIDE—30 BORD—SIDERITE AND PYRITE CONTENTS OF COAL AND MINERAL INCLUSIONS.

Fraction.	COAL. Floats in Carbon Tetrachloride.		SHALE. Sinks in Carbon Tetrachloride.		MINERAL. Sinks in Bromoform.	
Gravity	Less than 1·6		Between 1·6 and 2·89		Greater than 2·89	
Amount of fraction as a percentage of shale coal	97·5		2·0		0·5	
	Percentage of Fraction.	Percentage of Coal.	Percentage of Fraction.	Percentage of Coal.	Percentage of Fraction.	Percentage of Coal.
Pyritic Sulphur	0·17	0·17	2·12	·042	12·85	0·064
Sulphate Sulphur	0·006	0·006	0·036	·001	0·076	0·004
CO_2	0·13	0·13	6·29	·013	18·64	0·093
Fe_2O_3	0·91	0·89	12·44	0·249	53·63	0·268
CaO	0·67	0·65	0·4	0·008	0·46	·002
Ash	7·89	7·69	51·13	1·028	....	....
Probable Compositions—						
FeS_2	0·32	0·31	3·17	0·08	24·09	0·12
$FeCO_3$	....	....	14·20	0·37	48·38	0·24
Fe_2O_3	0·49	0·48	....	....	4·23	0·022
$CaCO_3$	0·30	0·29	0·60	0·012	0·58	0·003
$CaSO_4$	0·03	0·03	0·15	0·003	0·32	0·002
CaO	0·55	·48	....	....	....	....

The coal was separated from mineral inclusions by grinding to pass 1/8 inch mesh and selecting material which remained on 18 mesh and then floating off the coal with carbon tetrachloride. The sink fraction from the carbon tetrachloride separation was then subject to further separation with bromoform in which siderite and pyrite will sink and leave shale as middlings.

especially as the Collie boilers now carry a much higher peak load than they did in the past and, therefore, must operate over a much wider load range.

Conclusions.

The conclusions reached are:—

(1) That the siderite inclusions in Collie coal are not uniquely confined to the Co-operative East Side coal nor does their presence have any bearing on the behaviour in use of the Co-operative or any other Collie coal for the good reason that the actual percentage present is insignificant —less than 0.5% of the coal.

(2) The ash from Co-operative coal is not one which will give troublesome clinker on locomotive grates nor severe slagging when fired in pulverised form at power stations.

(3) The East Side coal contains 2%-3% more ash than the coal from the older Co-operative workings. This will lead to larger accumulations of ash in locomotive fireboxes and comment on this behaviour may have lead to its condemnation in the past.

(4) The fuel is similar in ash content and ash fusion characteristics to coal which is successfully used in modern pulverised fuel boilers. No aggravation of the normal front wall slagging of this type of boiler would be anticipated from Co-operative East coal, subject to suitable control of fuel size and burner throw.

(5) Trouble experienced at an older power station with Co-operative coal is apparently confined to areas of brickwork unscreened by boiler tubes. Trouble is experienced not because the ash fusion point of Co-operative East coal is too low for the regular operation of this boiler, but apparently because it is too high especially when the boiler is on low load. It is suggested that this behaviour is amendable to control and correction by particular attention to firing conditions on low load.

TABLE 14.

COAL ASH ANALYSIS.

Coal.	Co-operative older Workings 3897–3937/47.	Co-operative East Side. 4260/50.	Proprietary 10 Left Section 4253–4255/47.
SiO_2	50·0	47·82	36·4
Fe_2O_3	16·1	15·81	27·12
Al_2O_3	22·2	20·29	27·21
TiO_2	1·2	1·06	0·71
CaO	4·7	7·12	3·31
MgO	1·9 } 6·6	3·25 } 10·37	2·37
Mn_3O_4	0·2	0·20	0·67
P_2O_5	....	....	0·06
SO_3	3·7	5·34	3·21
Percentage Effective Silica	68·5	65·0	46·5

$$\% \text{ Effective Silica} = \frac{\% \text{ SiO}}{(\%Fe_2O_3 + CaO + MgO + SiO_2)} \times 100$$ and is a measure of fusibility. The higher the % Effective SiO_2 the less easily does the ash flux.

Note the only difference between the older Co-operative workings and the Co-operative East Side is a change in the sum of lime + magnesia = from 6.6 to 10.37.

TABLE 15.

ASH FUSION POINTS OF COLLIE COALS.

Coal.	Reducing Conditions.			Oxidising Conditions.		
	Softening Pt.	Blobbing Pt.	Fluid Pt.	Softening Pt.	Blobbing Pt.	Fluid Pt.
Co-operative Old Working, 1947	1135°C 2075°F	1165°C 2129°F	1180°C 2156°F	1280°C 2336°F	1330°C 2426°F	n.d. n.d.
Co-operative East Side, 1950	1160°C 2120°F	1185°C 2165°F	Above 1200°C Above 2192°F	1240°C 2264°F	1314°C 2390°F	1320°C 2406°F
Proprietary 10 Left Section	1065°C 1949°F	1095°C 2003°F	1130–1150°C 2066–2102°F	1270°C 2318°F	1300°C 2372°F	1330°C 2426°F
Cardiff, 1950	Above 1340°C Above 2444°F	n.d.	n.d.	Above 1380°C Above 2516°F	n.d.	n.d.
Black Diamond, 1949	1600°C 2912°F	n.d.	n.d.	n.d.	n.d.	n.d.

Fusion points are given for both reducing conditions, when the iron in the ash is in the ferrous conditions and for oxidising conditions, when the iron is in the ferric condition. Conditions are approximately set by adjustment of the furnace atmosphere. Ferrous iron has a more strongly fluxing action than ferric iron on the silica co-present.

TABLE 16.

ASH CONTENTS AND FUSION POINTS OF COALS FROM SIDERITE SECTION.

Mark.	Origin.	Ash Dry Basis.	Ash Fusion Temperature. (Reducing Conditions)
		%	
2327/48	No. 3 Bord	11·4	1340°C
3443/48	No. 6 Bord above Stone Band	9·40	1335°C
3444/48	No. 6 Bord below Stone Band	11·85	1310°C
4972/48	No. 6 Bord	10·28	1280°C
4973/48	No. 1 Bord	10·63	Over 1290°C
4974/48	No. 1 Bord	9·73	1250°C
7415/48	Face No. 14 Bord	10·98	1160°C
7416/48	Face No. 19 Bord	11·14	Exceptional 1140°C
1133/49	No. 14 Bord Engine Trial Coal	11·82	Exceptional 1240°C
1134/49	No. 14 Bord Engine Trial Fly Ash	37·40	1235°C
1135/49	No. 14 Bord Engine Trial Clinker	96·0	1240°C
1538/49	No. 23 Bord Further Engine Trial Coal	13·39	1238°C
1539/49	No. 23 Bord Further Engine Small Clinker	57·21	1240°C
1539/49	No. 23 Bord Further Engine Large Clinker	91·24	1240°C
8150/48	No. 14 Bord Rib Sample	9·74	1250°C
8151/48	No. 14 Bord Above Stone Band	10·51	1230°C
8152/48	No. 14 Bord Rib Samples	9·14	1250°C
8153/48	No. 14 Bord Below Stone Band	9·70	1250°C
647/49	No. 31 Bord	10·61	1165°C
648/49	No. 26 Bord	8·42	1165°C
649/49	No. 22 Bord	8·72	1135°C
4263/50	No. 9 Bord	10·8	1200°C
4268/50	No. 7 Bord	13·55	1235°C
4269/50	No. 30 Bord	10·7	1200°C

TABLE 17.

DETERMINATION OF FOUR SAMPLES OF MINERAL INCLUSIONS FOR COAL.
Collected at Collie on 13th–14th March, 1950.

Lab. No.	Marks.	Result of Examination.
	Cardiff, No. 2 Seam.	
3107	No. 1	Thin veins and scattered patches of bright yellow to dull greyish yellow sulphide mineral in coal. The sulphide is mainly marcasite with some pyrite. An appreciable amount of melanterite (hydrous ferrous iron sulphate) is present. Traces of opal and quartz were detected.
	Cardiff, No. 1 Seam.	
3108	No. 2	Similar to No. 1.
3109	Wyvern, No. 7 Right, No. 2 Bord No. 3	Similar to No. 1.
3170	Black Diamond Seam No. 4	Small veins and patches of marcasite partly altered to melanterite, in coal.

TABLE 18.

DETERMINATION OF FOUR SAMPLES OF MINERAL INCLUSIONS FOR COAL.
Collected at Collie on 23rd–24th May, 1950.

Lab. No.	Marks.	Result of Examination.
	Stockton No. 1 Seam Diagonal 1/16 in. Layers, 5 Rise, 14 Bord	
5382	No. 1	Thin seams and one nodule of sulphide in coal. The sulphide is an intergrowth of pyrite and marcasite. A little melanterite is present.
	Stockton No. 2 Seam Diagonal 1/16 in.	
5383	No. 2	Thin sheet like veinlets of siderite in coal. Occasional patches of sulphide, an intergrowth of pyrite and marcasite, are present and a little epsomite.
	Black Diamond-Inclusions.	
5384	No. 3	Thin flat veinlets of marcasite altering to melanterite in coal. Epsomite is present.
	Lenses of Pyrites from Co-operative, East Side, 30 Bord	
5385	No. 4	Small nodules of sulphide consisting of an intergrowth of pyrite and marcasite.

APPENDIX 2.

REPORT ON BLENDING OF COLLIE COALS WITH REGARD TO THEIR CLINKER FORMATION ON LOCOMOTIVE GRATES.

Summary.

Trials of individual coals have been conducted on:—

(a) on locomotive type workshop boilers.

(b) in use on locomotives on the road.

None of the coals tried inclusive of Co-operative East or Left Hand Side Coal forms clinker on the firebars of the workshop boilers. This is probably because the combustion conditions are not sufficiently intense.

In use on locomotives only Co-operative East forms marked accumulations of clinker on firebars though Griffin coal formed slight accumulations of thin sheet clinker when used on a PM locomotive.

Proprietary coal does not form any clinker; nor does Black Diamond or Cardiff.

The reason that Proprietary coal does not form clinker is that its ash fluxes easily at about 1100°C and apparently leaves the fire to some extent in fluid form as drips of clinker.

Black Diamond with an ash fusion point of over 1700°C and Cardiff with an ash fusion point of over 1400° does not clinker because conditions in the fire are not intense enough to flux their ashes preliminary to forming clinker.

Co-operative however lies between the two extremes with an ash fusion point of about 1200°C. The ash fluxes sufficiently to run in the fire but it does not get fluid enough to run freely through the bars in the way which seems characteristic of Proprietary. In consequence Co-operative ash accumulates in the fire to some extent as clinker.

It could be surmised from the foregoing generalisations that attempts to raise the ash fusion point of Co-operative coal by blending in Black Diamond or Cardiff coal would prevent clinkering with Co-operative coal. One trial with a blend of Cardiff and Co-operative appeared to substantiate this prediction.

Confirmation of this result from blending using Black Diamond as the anti-clinkering coal has not yet been obtained. It would be useful to do so as Black Diamond is at present loaded on the same gantry as Co-operative and is thus to some extent already mixed with it.

The accompanying tables refer to tests carried out of a number of coals from Collie (a) on the workshop boilers at Midland Junction; and (b) in use on locomotives. The tests have been undertaken to determine how individual coals behave as regards ash and clinker formation as a preliminary to work on blending of coals. Additionally one trial with a blend of Co-operative East (or Left Hand) coal and Neath (Cardiff No. 2) has been observed the results of which were satisfactory.

The work has been discontinued temporarily while the Railway Department observes working experiences with Co-operative large coal in parallel with and complimentary to the State Electricity Commission trials with small coal.

The results of the work done bear out closely predictions from experimental work on coals in the laboratory. It appears that the coals at Collie have an unusually wide range of ash fusion points and therefore the way in which their ashes behave is widely variable. At the low end of the scale, Proprietary and probably Stockton and in some circumstances Griffin possess ash which fluxes easily so that the fused ash to some extent drips from the fire in fluid condition and for this reason these coals do not form clinker in noticeable amounts. At the top end of the scale the Black Diamond and Cardiff coals have exteremely high ash fusion points, in consequence it is impossible for their ashes to flux together to form clinker. Intermediately there is the Co-operative coal of medium ash fusion point which does not flux readily enough to permit the ash to leave the fire in fluid condition but yet fluxes sufficiently easily to form clinker in noticeable amounts. The effect of mixing in a coal of high ash fusion point such as Cardiff with a coal of intermediate ash fusion point such as Co-operative is to produce a mixture with an ash fusion point sufficiently high to prevent formation of clinker, and this surmise has been demonstrated by one trial of Cardiff mixed with Co-operative East which gave clean fire conditions.

The foregoing possible explanation of the behaviour of the coal ash will be modified by such factors as: the occurrence of batt in the coal since lumps of batt act as centres round which clinker builds up—Stockton coal may be prone to behave in this way since the top part of the No. 1 Seam contains a band of batt which is difficult to isolate from the coal; the percentage ash content of the coal, since it controls the amount of ash clinker which will accumulate in a firebox, affects the degree of clinkering observed; a feature of the Co-operative East Coal is that its ash content is 2 to 3% higher than some of the better coals worked at Collie: the rate of firing also may have an influence on the clinker formation since fire bed temperature and the fluidity of fused ash both rise with increased rate of firing; in consequence at low rates of firing clinker is not formed, at higher rates it may be formed but there also appears to be a possibility that the ash becomes sufficiently fluid to run through the fire bars in slugs which freeze into globules of clinker during their fall into an ashpan.

In the tests on stationary boilers at Midland Workshops no coals (inclusive of the Co-operative East Side) formed clinkers. It is surmised that the rate of burning the coal on these boilers is too low (under 50lbs. per sq. ft. per hour) for the formation of clinker. The practice of frequent rocking of the grates of these boilers to keep the firebed clean is also a factor which prevents clinker formation. Locomotive trials showed that the ash from Black Diamond coal leaves the fire in completely unfused condition, that from Cardiff is only slightly sintered. Co-operative forms some clinker. Griffin also forms clinker when burnt at low rates of combustion—under 50 lbs. per sq. ft. of grate area per hour. Proprietary coal does not form clinker but gives rise to a slag which leaves the bars in fluid condition associated with completely unfused ash; and according to determinations made the ash fusion point of the fused material is 1170°C whereas that of the unfused is 1250°C. It also appears that locomotives fire conditions are not identical with those on stationary boilers: the average rate of combustion on the locomotive is higher and the instantaneous rate associated with the puffing of the engine is very much higher; additionally the locomotive fire is being continually disturbed and shaken by conditions on the road.

Additional facts which have emerged from the locomotive trials is that firemen and fire cleaners are accustomed to extremely clean firebed conditions with Collie coals. Coals which are exceptionally good in this respect are Black Diamond, Cardiff and Proprietary. The Co-operative East coal however forms clinker which gives dirty firebed conditions without however interfering with free burning of the fire. The accumulation of clinker is however noticed and may occasion adverse comment especially from fire cleaners.

This work is being pursued as and when coal users can provide opportunities to make observations. Co-operation in this matter is being sought from private consumers as well as from State utilities.

TABLE 19.

TABLE A. LOCOMOTIVE (CLINKERING) TRIALS.

Details of Trials and Observations.

Date of Trial.	Coal.	Engine. (Class).	Details of Journey and Load (Tons).	Rates of Firing lbs/sq. ft/hr. Approximate only.	Coal Burned (tons) lbs/ton mile.	Observations.
1–8–50	Proprietary	E	Perth to Pinjarra Load 247	....	....	Very light firing. No clinker. Ash pan contents not inspected.
22–8–50	Black Diamond	Fs	Midland Junction to Koojedda .... Load 218	Midland Junction to Chidlow—75 .... Chidlow to Koojedda—50	2 ·59	No clinker at Chidlow or Koojedda. Ash sample did not contain much unburnt coal. At Koojedda about 4 in. of cinders in the smoke box.
23–8–50	Griffin	Pr	Perth to Northam	Midland Junction to Chidlow—50 .... Chidlow to Northam—30	....	Thin sheet clinker formed. Ash pan unfortunately not inspected for drip clinker.
24–8–50	Proprietary	Es	Perth to Northam .... Load : Perth to Chidlow 170 Chidlow to Koojedda 270 Koojedda to Northam 190	Midland Junction to Chidlow—107 .... Chidlow to Northam—80	1·8 ·33	A few 3 in. lumps of clinker at Northam. Drip clinker in ash pans (plus ash). Concluded that clinker does not form because fused ash leaves the fire in fluid form.
5–9–50	Proprietary	PMr	Midland Junction to Koojedda .... Load 250	Midland Junction to Chidlow—33 .... Chidlow to Koojedda—42	1·97 ·50	Scarcely any clinker (small amounts to right and left of firing door). Further evidence of drip clinker. Fused globules amongst ash in ash pan.
7–9–50	Cardiff Neath	Fs	Midland Junction to Chidlow .... Load 225	Midland Junction to Chidlow—110	1·75 1·03*	No clinker. Ash pan contents were small pieces of batt, unfused ash, small pieces of white lightly fused clinker and unburnt coal. Rockings from the fire were small batt and coal. Smoke box—20 shovels of small coal and white ash.
14–9–50	Blend of Cardiff Neath and Co-operative E. Side Load 8	Fs	Midland Junction to Koojedda .... Load : Midland Junction to Chidlow 228 Chidlow to Wundowie 278 Wundowie to Koojedda 358	Bellevue to Hovea—96 .... Hovea to Sawyers Valley—6 .... Chidlow to Koojedda—48	2·2 .... ·53	No clinker in firebox at Chidlow or Koojedda. Ash pan contained ash small fused lumps of clinker. 17 shovels of cinders in smoke box at Chidlow. Admixture of the Neath Coal appears to prevent the clinker formation associated with the Co-operative East Side Coal.

* Trial confined to tank and 5 ft. heater tube coking.

TABLE 20.

STATIONARY BOILER TRIALS (RE CLINKERING) AT MIDLAND JUNCTION.

The boiler used in the trials was an E Class Locomotive Boiler and one of a bank of eight supplying steam to the workshops. The rate of fuel consumption for the first four tests was comparable to that of a locomotive with the same grate area. For the Neath and East Side (Co-op. Bord 8) Trials the rates were much lower but comparable with the rate (per unit area) on a locomotive with a large grate.

The load was varied, according to demand, by a steam jet which raised the draught in the 12 in. dia. stack from a typical 0·12 in. w.g. to 0·65 w.g.

Date of Trial.	Coal Sample and Lab. No.	Rate of Firing lb./sq. ft./hr.	Total Coal Burned. (Tons).	Coal Analysis.										Observations.
					Ash.			Ash Fusion °C						
								Reducing Atmosphere.			Oxidising Atmosphere.			
				Per cent. Moisture (As Analysed).	Per cent. as Analysed.	Per cent. Dry Basis.	Colour.	Softening.	Blobbing.	Fluid.	Softening.	Blobbing.	Fluid.	
7–8–50	Griffin Coal 7530/50	46 (1 Shovel = 20 lb.)	2·5	17·85	4·1	4·95	Red Brown	1145	1210	1375	1310	1350	1400	This coal *formed most clinker* of the coals observed but the total *remaining on the bars was slight.* Since the batt content appeared fairly high the clinker may have formed on this as later observed in the Co-operative East Side trial.
8–8–50	Proprietary Coal 7531/50	46	5 (2 days)	17·45	6·6	8·0	Dark Reddish Brown	1145	1175	1340	1265	1340	1380	*Every opportunity was given to form clinker.* The fire was not cleaned after the first days run and next morning it was dirty ; the boiler did not steam well. Rocking the grate however sent most of the dirt through (the grate was not even rocked on the first day) and when cleaned at the end of the second day there was *scarcely any clinker.*
10–8–50	Co-operative West (Right) Coal 7532/50	46	5 (2 days)	18·65	7·3	8·95	Light Brown	1240	1370	1425	1420	1490	1500	*Scarcely any clinker formed.*
14–8–50	Black Diamond 7533/50	32 (Weighed)	5 (2 days)	16·85	6·4	7·7	White	1500	....	....	1500	....	....	*No clinker formed.* A sample from the ash pit consisted of white ash with a small amount of unburnt coal.
11–9–50	Cardiff Neath	20–22 (Average) up to 26	2½	24·0	7·45	9·8	Fawn	1375	1415	1460	....	....	....	*No clinker formed.* A sample from the ash pit was similar to the ash pen sample from the rail trial on Neath coal 7–9–50. White ash and lightly sintered material.
13–9–50	Co-operative East Side—Bord 8. (Left)	20–22 (Average)	2½	16·65	9·55	11·5	Brown	1200	1225	1235	1220	1245	1330	*Periodic examination revealed no clinker formation.* When the fire was rocked and raked at the end of the day only a few small lumps of *batt covered with fused clinker on the bars.* The ash pit contained ash and small (up to 1 in.) fused clinker. Some of the smaller nodules may have *dripped* through the bars while fluid.

TABLE 21.

LOCOMOTIVE CLINKERING TRIALS.

Analysis of Coal and Ash Samples.

Date of Trial.	Details of Trial. (*See* Table A for Complete Details.)	Analysis of Coal Sample.												Ash and Clinker Samples.											
		Lab. No.	Moisture as Analysed.	Ash.			Ash Fusion °C/°F.							Lab. No.	Nature of Sample.	Fusion Points °C/°F.						FeO.	Fe_2O_3.
				As Analysed.	Dry Basis.	Colour.	Reducing Atmosphere.			Oxidising Atmosphere.						Reducing Atmosphere.			Oxidising Atmosphere.				
							S.	B.	F.	S.	B.	F.				S.	B.	F.	S.	B.	F.		
				%																		%	%
26–7–50	Co-operative East Side Coal—Bord 9	7639/50	19·0	9·05	11·15	Brown	1150 2100	1215 2200	1335 2435	1300 2372	1340 2444	1400 2552	....	....	....	....	....	....	....	....	....	....	....
24–7–50	Co-operative East Side Coal—Bord 10	7640/50	18·1	9·35	11·4	Brown	1180 2155	1195 2185	1215 2220	1245 2273	1270 2318	1360 2480	....	....	....	....	....	....	....	....	....	....	....
20–7–50	Co-operative East Side —Midland Junction	7534/50	17·4	8·0	9·7	Brown	1100 2012	1165 2129	1280 2336	1250 2282	1280 2336	1365 2489	....	....	....	....	....	....	....	....	....	....	....
20–7–50	Co-operative East Side —East Perth	7535/50	18·25	8·95	10·95	Light Brown	1155 2111	1165 2129	1335 2435	1300 2372	1340 2444	1400 2552	....	....	....	....	....	....	....	....	....	....	....
1–8–50	Proprietary Coal, Perth to Pinjarra Class E Engine	7162/50	20·3	6·9	8·65	Brown	1065 1949	1100 2012	1160 2120	1250 2282	1290 2354	1330 2426	7163/50	Clinker		1120 2048	1190 2174	1260 2300	....	....	....	13·57	3·60
22–8–50	Black Diamond Coal, Midland Junction to Koojedda Class FS Engine	....	0·7 4·45	62·8 62·2	63·3 65·1	Grey-Brown Grey-Brown	....	....	....	....	....	....	7708/50 7709/50	Fire box Sample. (Ash and coal). Fire box sample. (Ash and coal)	Approx. 1490 2715 1490 2715	.... 1490	....	1500 2732 .... 1500 2732	....	....	....	....	....
23–8–50	Griffin Coal. Perth to Northam, Class PR Engine	7913/50	18·9	4·9	6·0	Red Brown	1080 1975	1130 2065	1230 2245	1260 2300	1295 2363	1350 2462	....	....		....	....	....	....	....	....	....	....

TABLE—21—*continued.*

LOCOMOTIVE CLINKERING TRIALS—*continued.*

Analysis of Coal and Ash Samples.

Date of Trial.	Details of Trial. (*See* Table A for Complete Details.)	Analysis of Coal Sample.												Ash and Clinker Samples.										
		Lab. No.	Moisture as Analysed.	Ash.			Ash Fusion °C/°F.							Lab. No.	Nature of Sample.	Fusion Points °C/°F.						FeO.	Fe_2O_3.
				As Analysed.	Dry Basis.	Colour.	Reducing Atmosphere.			Oxidising Atmosphere.						Reducing Atmosphere.			Oxidising Atmosphere.				
							S.	B.	F.	S.	B.	F.				S.	B.	F.	S.	B.	F.		
				%																			
24–8–50	Proprietary Coal, Perth to Northam, Class ES Engine	7914/50	20·8	6·8	8·6	Red-Brown	1110 2030	1150 2100	1260 2300	1300 2372	1340 2444	1400 2552	....	Ash and Clinker, (a) Small Clinkers, (b) Unfused Ash	1115 2039 1160 2120	1160 2120 1250 2282	1170 2138 (intumescence at 1250°)	....	....	....	....	....
5–9–50	Proprietary Coal, Midland Junction to Koojedda, Class PMR Engine	8381/50	19·8	6·65	8·3	Red-Brown	1125 2055	1250 2280	1280 2335	n.d.	n.d.	n.d.	8382/50	Clinker sample : (a) Ash Fines .... (b) Clinker	1190 2175 1135 2075	1240 2265 1170 2140	1300 2370 1260 2300	1305 to 1320 2381 to 2408	1360 2480	1390 2534	....	....
7–9–50	Cardiff Neath Coal, Midland Junction to Chidlow, Class FS Engine	8471/50 Volatile matter 25·30 per cent.	27·55	7·85	10·85	Light Fawn	....	....	....	....	....	....	8472/50	Clinker and Ash, (a) White ash, (b) White Clinker, (c) Black Clinker	1420 2590 1405 2560	1460 2660 1450 2640	1500 2730 1500 1730	1460 2660 1445 2630	1480 2695 1500 2730	1500 2730 1500 2730	....	....
....	....	....	23·75	13·0	17·05	Off White	1500 2730	....	....	1500 2730	....	....	8473/50	Alleged Batt taken from coal	1150 2100	1185 2165	1270 2320	1310 2390	1360 2480	1410 2570	....	....

APPENDIX 3.

Work Done in Connection with Boiler Trials at East Perth A Power Station Using Co-operative East Side Coal.

SUMMARY.

Observations made at East Perth Power Station show that Co-operative East Coal can be used on the chain grate boilers of the A Station. It appears that the coal burns without trouble when admixed with other coals from Collie, especially Cardiff coal.

The siderite content of regular samples collected at Collie averaged 1.05 per cent. The ash content of the coal was 11.55 per cent. as sampled at East Perth and 12.0 per cent. as sampled at Collie, the calorific values being respectively 9,060 and 9,095 B.T.U. per cubic feet.

The ash fusion points average 1150°-2100°F and this figure is a normal one for the majority of the Collie mines.

The coal continues to be sampled and checked regularly by us through the agency of our Chemist at Collie.

Opportunity has been afforded to observe the Co-operative Coal in use on chain grate stokers at East Perth A Station during October and November. Until 22nd November the coal was isolated to two boilers where it did not give complete satisfaction as it did not balance up with boilers on the run-of-the-field coal mixture which shared common stacks and induced draft fans with the Co-operative coal. It appeared that the Co-operative coal got the less amount of draught and burned less freely.

Subsequently the Co-operative coal was allowed to mix in with the run-of-the-field coals and no longer discernibly affected the operation of the boilers. It can be surmised that a good deal of Cardiff coal would be blended in this way with the Co-operative coal and the result confirms the view which has been held for some time now that Co-operative and Cardiff provide a satisfactory blend.

A considerable amount of analytical work has been conducted in connection with the test. Samples were collected by the power station at East Perth (Table 24) and also by Amalgamated Collieries at Collie (Table 24A). Both were referred to us and their analyses appear to be in good agreement.

It is indicated that although the power station samples were given to us daily there was a wide variation in the analysis of the coal from day to day arising from deficiencies in sampling procedure. In consequence the power station samples were subsequently grouped to average out sampling errors. Results supporting this procedure are given in Table 23, where it should be emphasised that such a figure as 16.8 per cent. of ash for sample No. 6 is due to the foregoing defects in sampling and is not characteristic of the ash content of the coal sampled.

The ash content of the coal is returned as 11.55 per cent. and 12.00 per cent. on a 20 per cent. water basis as sampled at East Perth and at Collie respectively and the corresponding calorific values are 9,060 and 9,095 B.Th.U./lb. The calorific value of the Collie sample is a little higher perhaps because it has been worked up and analysed with due regard for the minimum exposure to air to avoid oxidation.

The ash fusion point of the coal lies in the neighbourhood of 1150°C-2100°F appears to be about the correct figure. The samples taken at Collie are here almost 100°F below those sampled at East Perth over all samples. It is difficult to explain this discrepancy. It is not inaccuracy in the determination as it is exemplified in some degree for all samples as well as in the determination made on composite samples for the whole period of sampling.

The siderite content of the coal (Table 25) was made on the Collie sample only, because only at Collie is there the necessary apparatus for making the proper and preliminary isolation of siderite from the coal by sink and float methods. The result obtained is 1.05 per cent. of siderite and 0.26 per cent. of the equally undesirable pyrites mineral, making 1.31 per cent. in all contributing only 7.5 per cent. as iron oxide of the total ash content. As siderite will be most plentiful in the small sizes of coal this relative low figure is reassuring and bears out what we have said in previous reports on siderite content of Co-operative coal.

It is understood that as the result of their tests, the power station feels that they can continue to accept Co-operative coal. We, as a safeguard on maintenance of present quality, are receiving regular samples from the Co-operative gantry at Collie on which we will report at intervals.

TABLE 22.

MOISTURES AND ASHES ON SAMPLES 1–15 EX EAST PERTH POWER STATION.

Sample.	Percentage Moisture (Air Dry).	Percentage Ash (Air Dry).	Percentage Ash (As received).	Percentage Ash (Dry).
1	15·40	12·40	11·75	14·65
2	15·70	11·85	11·25	14·05
3	17·20	12·25	11·85	14·80
4	17·10	12·10	11·70	14·60
5	16·00	12·20	11·60	14·55
6	16·70	16·80	16·15	20·15
7	14·75	12·90	12·10	15·15
8	14·60	13·95	13·10	16·35
9	15·30	11·90	11·25	14·05
10	17·20	11·25	10·85	13·60
11	16·25	11·60	11·10	13·85
12	16·50	12·30	11·80	14·75
13	16·35	12·25	11·70	14·65
14	16·50	11·70	11·20	14·00
15	16·30	13·20	12·60	15·75
Total	241·85	188·65	180·00	224·95
Average	16·10	12·55	12·00	15·00
Compare these Average figures with Composite Sample figures.	15·95	12·45	11·85	14·80

TABLE 23.

SAMPLES OF CO-OPERATIVE COAL COLLECTED AT EAST PERTH POWER STATION AND ANALYSED BY THE GOVERNMENT LABORATORY.

Identity of Sample.	As Analysed Basis.						Dry Basis.	Dry Ash Free Basis.		Fusion Point.		
	Moist.	Ash.	V.M.	F.C.	Sulphur.	C.V.	Ash.	V.M.	C.V.	Soft °C °F	Blobb. °C °F	Fluid °C °F
Composite A (1–15 incl.) Received 21/9/50–9/10/50—9758–9760/50	15·95	12·45	21·45	50·15	0·43	9465	14·80	29·95	13225	1125 2057	1145 2093	1235 2255
Composite B (16–26 incl.) Received 10/10/50–22/10/50—10124/50	14·55	11·85	22·35	51·25	0·36	9845	13·85	30·40	13230	1125 2057	1150 2102	1225 2237
Composite C (27–29 incl.) Received 24/10/50–27/10/50—10256–58/50	15·15	12·60	21·85	50·40	0·33	9580	14·85	30·25	13230	1115 2039	1155 2111	1260 2300
Composite D (1A–10A incl.) Boiler House 20/10/50–31/10/50, 11797–98, 10259–62/50, 11799/11802	15·70	13·00	22·05	49·25	0·41	9380	15·40	30·90	13160	1135 2075	1180 2156	1220 2228
Composite E (30–39 incl.) Received 28/10/50–10/11/50, 11803–11812/50	14·40	12·05	22·25	51·30	0·35	9760	14·10	30·25	13270	1140 2084	1170 2138	1200 2192
Composite F (11A–20A incl.) Boiler House 1/11/50–17/11/50, 11813–11822/50	13·50	12·55	22·75	51·20	0·38	9740	14·50	30·65	13170	1150 2102	1190 2174	1240 2264
Composite G (40–49 incl.) Received 12/11/50–24/11/50, 11823–32/50	13·20	11·45	23·75	51·60	0·44	9960	13·20	31·50	13210	1140 2084	1165 2129	1230 2246
Composite H (50–54 incl.) Received 26/11/50—unknown, 11833–37/50	13·00	12·75	23·55	50·70	0·42	9820	14·65	31·70	13215	1120 2048	1155 2111	1225 2237
Composite I (21A–26A) Boiler House 22/11/50—4/12/50—Co-op. E. Side and Cardiff, 11838–42/50	15·15	12·10	24·00	48·75	0·55	9430	14·25	33·00	12970	1235 2255	1260 2300	1320 2408
Average of Composites A–H incl.	14·45	12·35	22·50	50·70	0·39	9690	14·40	30·70	13210	1130 2066	1165 2129	1230 2246
Average of Composites A–H incl. on 20 per cent. basis	20·00	11·55	21·05	47·40	0·37	9060	14·40	30·70	13210	....	....	....
Fusion Point on Actual Composite A–H incl.	....	....	....	....	....	....	....	....	....	1140 2084	1175 2147	1265 2309

TABLE 24.

SAMPLES OF CO-OPERATIVE COAL COLLECTED BY AMALGAMATED COLLIERIES AT COLLIE FROM CO-OPERATIVE COAL DESPATCHED TO EAST PERTH POWER STATION.

Identity of Sample.	As Received Basis.						Dry Basis.	Dry Ash Free Basis.		Fusion Point.		
	Moist.	Ash.	V.M.	F.C.	Sulphur.	C.V.	Ash.	V.M.	C.V.	Soft. °C °F	Blobb. °C °F	Fluid °C °F
S.E.C. No. 1, 10238/50, 21/9/50–21/10/50	21·65	11·70	20·80	45·85	0·49	8910	14·90	31·25	13360	1100 2012	1140 2084	1230 2246
S.E.C. No. 2 and 3 Combined, 10792/50 and 10712/50, 23/10/50–3/11/50	19·85	11·85	21·30	47·00	0·48	9375	14·80	31·20	13730	1090 1994	1120 2048	1190 2174
S.E.C. No. 4, 10713/50, 6/11/50–11/11/50	19·80	12·15	21·40	46·65	0·51	9015	15·15	31·45	13240	1100 2012	1140 2084	1220 2228
S.E.C. No. 5, 11048/50, 13/11/50–18/11/50	18·40	12·25	21·85	47·50	0·52	9200	15·00	31·55	13270	1100 2012	1130 2066	1220 2228
S.E.C. No. 6, 11205/50, 20/11/50–25/11/50	20·05	12·00	21·20	46·75	0·51	9080	15·00	31·15	13360	1100 2012	1140 2084	1230 2246
S.E.C. No. 7, 11454/50, 27/11/50–2/12/50	19·85	12·00	21·65	46·50	0·49	9050	14·95	31·80	13280	1120 2048	1140 2084	1220 2228
S.E.C. No. 8, 11630/50, 4/12/50–8/12/50	18·80	12·45	21·45	47·30	0·48	9100	15·35	31·20	13230	1100 2012	1140 2084	1220 2228
S.E.C. No. 9, 11708/50, 11/12/50–15/12/50	17·95	11·85	21·40	48·80	0·38	9410	14·45	30·45	13390	1150 2102	1170 2138	1280 2336
Average of Composites S.E.C. No. 1, S.E.C. No. 7 incl.	19·95	12·00	21·35	46·70	0·50	9105	14·95	31·40	13390	1100 2012	1135 2075	1220 2228
Average of Composite S.E.C. No. 1—S.E.C. No. 7 on 20 per cent. basis	20·00	12·00	21·35	46·65	0·50	9095	14·95	31·40	13390	....	....	....
Fusion Point on actual Composite S.E.C. No. 1—S.E.C. No. 7	....	....	....	....	....	....	....	....	....	1090 1994	1125 2057	1215 2219

TABLE 25.

SIDERITE AND MINERAL ANALYSIS ON POWER STATION SAMPLES.

S.E.C. No.	Per cent. S.G. 2·89 in S.G. 1·5 fraction.	Dry Basis in S.G. 2·89. per cent.							Excess CO_2.
		Ash.	Fe_2O_3.	SO_4 S.	Pyr. S.	CO_2.	Pyrites FeS_2.	Siderite, $FeCO_3$.	
1	11·7	63·02	57·02	0·43	8·43	27·9	15·8	67·5	2·2
2	18·2	63·71	57·92	0·33	6·91	28·2	12·9	71·6	1·0
3.	16·2	62·79	56·96	0·47	8·6	26·6	16·1	67·1	1·1
4	13·5	62·27	57·24	0·38	8·66	26·1	16·2	67·4	0·5
6	20·2	63·71	56·18	0·41	7·07	28·4	13·2	68·8	2·4
7	13·1	63·19	55·13	0·36	8·94	27·2	16·7	63·9	2·9
8	16·4	63·62	56·01	0·41	9·96	25·5	18·6	63·3	1·4
Average	15·6	63·19	56·64	0·40	8·37	27·1	15·7	67·1	1·6

These samples were collected at Collie to give a heavy fraction of S.G.—1·5 and despatched to the Laboratories. They were further concentrated by separating in bromoform of S.G. 2·89 and drying in the air oven at 105°C. The moisture content of the original fraction (S.G.—1·5) was likewise determined. Assays consisting of Ash, Fe_2O_3, sulphate and pyritic sulphur and carbon dioxide were performed on the heavy fractions and the probable contents of pyrites and siderite were calculated, assuming that all the pyritic sulphur is combined as FeS_2.

TABLE 26.

CO-OPERATIVE WASHING TESTS.
1 C (1/8).

The coal was separated at Collie into six fractions as follows: S.G. 1·3, 1·3—1·35; 1·35—1·4; 1·4—1·5; 1·5—1·6, > 1·6.

Composite samples were made of these having S.G. of < 1·4; 1·4, > 1·4. The siderite and pyrites contents were assayed.

	S.G. < 1·4	1·4	> 1·4
Per cent. fraction in original coal	79·6	10·0	10·4
H_2O	11·43	12·6	5·82
Ash	6·7	14·45	41·25
CO_2	0·18	0·5	8·51
SO_4 S	0·0046	0·09	0·45
Pyr. S.	0·305	0·52	6·35
Calculated on Dry Basis—			
Per cent. fraction in original coal	80	10·18	9·82
CO_2	0·18	0·51	8·05
Fe_2O_3	0·91	1·99	22·9
CaO	0·42	0·18	0·67
Pyr. S	0·31	0·53	6·00
Ash	6·75	14·72	39·00
Calculated on 20 per cent. H_2O Basis—			
FeS_2	0·41	0·72	8·02
$FeCO_3$	0·34	0·96	15·15
Percentage of Original Coal on 20 per cent. H_2O—			
FeS_2	0·30	0·066	0·71
$FeCO_3$	0·24	0·089	1·35
Total in Orig. coal FeS_2 1·08 $FeCO_3$ 1·68			

Assuming that the water content of the original coal was 15.0% and assuming that all the siderite and pyrites is in the heavy fraction of S.G. 2.89, their contents in the original coal was calculated on a 20% water basis*.

TABLE 27.

S.E.C. No.	Per cent. Pyrites in Orig. coal on 20 per cent. H_2O basis.	Per cent. Siderite in Orig. coal on 20 per cent. H_2O basis.
1	....	....
2	0·25	1·41
3	0·36	1·51
4	0·18	0·74
6	0·22	1·16
7	0·16	0·62
8	0·25	0·86
Average	0·26	1·05

* The analyses conducted on samples of Co-operative coal through ¼ on ⅛" screen give FeS_2 = 1·08 per cent.; $FeCO_3$ = 1·68 per cent., the results being given in Table 26. Figures reported previously for pillar samples from tye mine gave $FeCO_3$ less than 0·5 per cent. More siderite inevitably accumulates in small coal.

Appendix 4.

Work on Refractories.

Work on refractories has been confined to tests made by firing refractories under light load (1.5 p.s.i) to a maximum temperature of 1650°C or such lower temperature as the specimen fails. Optical and analytical examination, porosity tests, etc., have been conducted by the Deputy Government Analyst as and when required. The combined work has been of considerable value to makers and users of refractory bricks. The work confirms that a high standard of firebrick is made in this State.

In one instance work has been done with a user —the State Shipping Service—which instances the type of co-operative work between engineers and a research laboratory which is particularly fruitful in the field of refractories because it is one where results usually require long period observations by users in conjunction with period inspections and examination by the refractories chemist.

The initial complaint was of serious refractory failure of an oil fired furnace lining. In the course of the work a number of different firebricks and two cements were tested. The temperature of the furnace was also measured both by pyrometer and by long period observation of Segar cones. The conclusion was ultimately reached that a cement which was used for rendering the brickwork fluxed at the operating temperature of the furnace and eroded the furnace lining. It was recommended that the use of the cement should be discontinued other than for jointing of the bricks where it appeared to give a firmly knit bond of the kind imperative for a ship's boilers. It was also confirmed with the engineer that anyone of several brands of West Australian firebrick would give as good or perhaps better service than Eastern States or imported firebrick.

As a consequence of the work the frequency of relining of the boilers of the particular class of ship worked on is reduced, and there is now no risk of furnace lining collapse limiting a rate of oil firing below that necessary to attain normal economical speed rating.

Experimental work on which the above conclusions are based is as follows:—

Refractories Under Load of Bricks from S.S. "Dulverton" (*Load = 1·25 p.s.i.*).

	Per cent. Collapse. Eastern States Bricks.		West Australian Brick.
	Coarse Brick	Fine Brick	
Temp. °C.	4671/49	4672/49	4873/49
1250	0·0	0·0	0·4
1300	0·4	1·1	0·5
1350	0·7	1·9	0·6
1400	2·4	2·7	1·0
1425	4·0	3·1	1·5
1450	5·5	3·9	2·1
1475	7·8	5·0	2·8
1500	11·3	7·2	3·8
1525	15·3	8·7	....
1550	....	12·4	6·0
1600	....	....	8·0
Comment	Collapsed from 1400° C.	Collapsed from 1300° C.	Slow Collapse from 1450° C.
Analysis—			
SiO_2	57·77	59·77	N.D.
Al_2O_3	37·22	34·50	N.D.
Fe_2O_3	4·50	4·38	2·5
CaO, etc.	Trace	Trace	....
Apparent Porosity	32·7	27·4	....

Refractoriness Test of Rendering Cement—

4870/49	Reducing Atmosphere.	Oxidising Atmosphere.
Softening point °C.	1325	1340
Blobbing point °C.	1455	1460
Fluid point °C.	1530	1530

The relatively low refractoriness is associated with an Na_2O content of 3·63 per cent.

Refractoriness Under Load (1·25 p.s.i.) *of Refractory Material for S.S. "Dorrigo" and "Dulverton."*

	Per cent. Collapse. West Australian Firebricks.			Fireclay Cement
	A.	B.	C.	
Temp. °C.	6014/50	6016/50	6017/50	6015/50
1250	0·0	0·0	0·0	0·0
1300	0·0	0·6	1·1	0·0
1350	0·0	0·9	3·2	0·0
1400	0·0	1·4	5·4	1·0
1450	1·0	6·0	6·6	3·0
1500	2·4	11·6	9·7	7·6
1550	5·0	23·7	12·9	13·3
1600	8·7	29·4	17·6	22·0
1650	12·8	....	22·2	....
1685	26·4	....	....	....

Subsequently panels of four different West Australian firebricks were built into the back wall of one furnace of s.s. "Dulverton." Tests of these bricks are set out 6183/50-6186/50. Segar cones were placed against the panels. These bricks had neither failed nor spoiled after one round trip of 56 days and a final report states that after 3,000 hours steaming the bricks were still satisfactory and it was possible to select from amongst them one suitable for routine use.

In these tests the Segar cones indicated maximum temperatures of over 1410°C. and below 1460°C.

Refractoriness Under Load Tests (1·25 *p.s.i.*) *of West Australian Firebricks.*

Temperature °C.	6183/50 Brick D.	6184/50 Brick E.	6185/50 Brick F.	6186/50 Brick H.
1200	0·0	—0·8	—0·1	0·0
1250	0·0	—1·0	—1·0	0·0
1300	—0·5 @ 1280 —0·2 @ 1300	—1·0	+0·4	1·0
1350	1·5	+0·7	2·0	2·3
1400	3·6	2·3	3·4	3·8
1450	5·8	3·9	5·4	5·7
1500	11·3	6·1	7·8	9·9
1550	—16·0	10·0	11·2	16·5
1600	18·4	25·8	13·6	17·5 @ 1560
Per cent. Collapse by measurement				
Cold to Cold	13·0	26·8	12·6	10·0
Apparent Porosity—				
As received	31·1	30·99	36·77	33·93
After heating to 1400°C.	28·34	22·64	29·54	33·80
Analysis—				
SiO_2	65·01	67·2	69·20	80·42
Fe_2O_3	2·14	1·79	1·52	1·51
Al_2O_3	30·22	28·05	28·52	17·55
TiO_2	1·52	0·36	0·42	0·26

Division VIII.

Annual Report of the Chief Inspector of Explosives for the Year 1950.

The Under Secretary for Mines:

I have the honour to submit for the information of the Hon. Minister for Mines, in compliance with Section 45 of the Explosives Act, 1895, my report on the working of the Branch for the year 1950.

The quantity of explosives imported into the State during the year is shown in Table No. 1, and Table No. 2 gives a comparison with the quantities imported during the past five years.

TABLE 1.

Importation of Explosives into Western Australia during 1950.

		lb.
Gelignite		3,215,850
Gelatine Dynamite		180,300
Permitted explosives		179,800
Blasting powder		52,300
		3,628,250
Detonators: Number	No. 6	2,400,000
	Electric	226,000
Fuse (Yards)		5,324,800

TABLE No. 2.

Explosives.	1946.	1947.	1948.	1949.	1950.
	lb.	lb.	lb.	lb.	lb.
Gelignite	3,038,950	3,379,650	2,817,700	3,098,900	3,215,850
Gelatine Dynamite	279,500	548,800	346,650	437,500	180,300
Permitted Explosives	472,250	443,750	621,600	932,500	179,800
Powder (Blasting and Pellet)	15,000	22,500	35,500	55,000	52,300
Detonators	2,543,500	3,360,000	3,514,000	3,750,000	3,626,000
Fuse (yards)	4,318,533	5,344,800	5,085,600	4,845,600	5,324,800

The following tests were made during the year for the purpose of determining the suitability for use, chemical stability, and velocity of detonation of explosives:—

Explosives	1,600
Fuse	346

The following table shows the number of Licenses issued during the year:—

Magazines on Government Reserves	53
Magazines used in Government Departments and on private property	131
Store Licenses Mode A	77
Store Licenses Mode B	1
Fireworks Licenses	492
Importation Licenses	2

The quantity of explosives used in the different classes of industry for the year 1949 and 1950 is given hereunder:—

	1949 lb used.	1950 lb. used.
Gold Mining	3,241,300	3,252,650
Coal Mining	261,000	323,700
Agriculture	85,600	86,200
Quarrying	156,200	160,100
Mining and Base Metals	66,500	64,300
Government Departments	65,570	81,450
Miscellaneous	90,280	98,950
	3,966,450	4,067,350

Metropolitan and country inspections during the year did not reveal any breach of the Act warranting prosecution, although there was occasional evidence of indifference and forgetfulness. The worst instances were in the South-West, where two lots of old gelignite had deliquesced to the extent of creating a fire hazard by saturating their surroundings with ammonium nitrate solution. The undermentioned explosives were either seized by or submitted to this Department for destruction:—

Date.	Place.	Kind and Quantity.	Reason for Destruction.
February	Ludlow	20 lb. Gelignite 60 30 Detonators	Severe moisture absorption
February	Kirup	4 lb. Gelignite, coils of fuse	Severe moisture absorption
March	York	1 plug Gelignite	Old, deformed, wrapper torn
August	Kalgoorlie	1,750 lb. Quarry Monobel	Moisture absorption and termite attack
August	Maylands	20 lb. Gelignite 300 detonators	Old stock, indurated Old stock
August	Woodman's Point	200 lb. Quarry Monobel	Induration and contamination by mineral oil
August	Collie	Approx. 1 case fuse	Deteriorated by mud, burnt erratically.
October	Woodman's Point	11 coils fuse on account W.A.G.R.	Doubtful history.

Commercial explosives aggregating 68,565 cases reached the State in nine vessels, and 4,000 cases arrived by Commonwealth Railway. All except one English consignment and small quantities of whaling powder were of Australian manufacture. About 1,600 heat-test determinations established that chemical stability met legal requirements. Physically, a moderate incidence of out-of-roundness occurred even where pre-formed shells had replaced manually-applied wrappers. Two successive shipments of Polar A2 Monobel had to be overhauled plug by plug because of deterioration by water before despatch.

Twenty-five cases of gelignite stolen from a colliery magazine and two falling from a rail van near Yellowdine have directed attention to greater security in locking, and steps are being taken to attain this objective.

There is one aspect of explosives conveyance to which, in the interest of public safety, it is felt desirable to direct official attention. Every week for years past two and sometimes three or four goods trains, each of which may be laden to the maximum permitted amount of 1,100 cases of 27.5 short tons of explosives, have travelled from Woodman's Point to the marshalling yards at Fremantle, through the station, past all suburban stations to Perth and thence north, south or eastward according to destination. The proximity of this line to residential and business areas, to large hospitals and schools and to industrial establishments east of Perth has long focussed attention on alternative routes. In no circumstances would an unmounded stationary magazine licensed for the above quantity of explosives be permitted nearer than 515 and 2,000 yards to dwellings and hospitals, respectively, and yet these amounts are regularly hauled within the proverbial stone's throw thereof. The fact that no major accident has occurred with explosives in rail transit locally or in other States beset by similar problems does not absolve us from a continual drive for greater safety. High hopes were raised on October, 27th by a Press report indicating that the building of a line from Fremantle through country south of Perth was under Governmental consideration.

Without knowing its route, or as to whether Perth would be by-passed for a more easterly junction with the main line, a full appraisal of the scheme's merits from the explosives angle is at present impossible. If the Bunbury line were joined at Welshpool, the projected extension to Bassendean would permit of an almost complete deviation from populous metropolitan districts.

Three accidents with explosives, all involving serious injuries, were investigated. At a Gosnells quarry on July 31st, a powder monkey sustained several fractures, later involving amputation, when a glancing blow from his tamping rod fired a charge in a shallow hole during popping. The following day in Brunswick Junction another workman was similary injured through charging a hot bulled hole. The third explosion, on December 17th at Gidgiegannup, resulted in fractures of both legs when a young man returned prematurely to a timber splitting gun of which the fuse had been lit. The human factor operated adversely in all three accidents, there being no evidence of defective materials.

Recent requests for additional magazines at the Kalgoorlie Explosives Reserve have had to be set aside until the shipping situation improves. The desirable objective of a five-month advance stock on the Eastern Goldfields has been impossible of attainment, despite all efforts to secure augmented supplies.

On July 25th at Roelands Quarry between 80,000 and 90,000 tons of granite and diorite were brought down in a single blast by 18,000 lb. of explosives comprising Monobel and Gelignite primed with Gelatin Dynamite. Detonation was by instantaneous fuse, with accessory provision for electrical firing. The result was satisfactory, although the unwieldly size of some of the dislodged rock masses suggested future placing of a greater number of smaller charges.

Since extensions to Woodman's Point Explosives Reserve jetty were completed midyear, m.v. Taranui has berthed alongside on all three visits. Expensive lightering operations and concomitant additional handling are thereby eliminated. If this vessel loaded to its licensed capacity of 16,000 cases were to arrive six or seven times annually, the supply position would be assured.

Apart from their destructive activities, termites in magazine buildings are regarded with apprehension because their acidic secretions may initiate chemical instability in stored explosives. Recently a private firm of pest exterminators was engaged on a three-year contract to check the depredations at Woodman's Point Area. Quarterly inspections and treatment are undertaken, and reports submitted on the progress of the work.

The semigelatinous explosive Semigel, introduced last year, was authorised on July 5th. It shows promise of supplementing or even supplanting some of the gelignite types, and will undoubtedly bridge the gap between these and the low-brisance Monobels.

Mr. T. K. Wood, of this department, was gazetted as Sub-Inspector of Explosives on the retirement of Mr. J. F. Moir, a former Fremantle Harbour Trust officer who was responsible for supervising transhipments of explosives in Gage Roads. The advantages of such an appointment, for which Mr. Wood is well qualified, are obvious inasmuch that direct control has now replaced dependence on an officer, however conscientious, responsible to another organisation.

In addition to small quantities of fireworks for professional display, 1,625 cases arrived by 31 shipments and three railages. Several large importations months before November 5th focussed attention on the desirability of storage in private magazines rather than city warehouses, or the wider use of facilities provided at the explosives reserve. Although no prohibited chemical admixtures were detected, objection was raised in some instances because of inadequate labelling. One type of Roman Candle, for example, burnt innocuously until disintegrated by a sharp explosive charge. Had this been held by hand—and there was no injunction to the contrary—injury would have resulted.

Samples of fuse resembling the commercial article were submitted by H.M. Chief Inspector of Explosives, London, for opinion as to suitability in fireworks. Ignition proved difficult, and except for its steady burning rate, the innovation appeared to offer no advantage over the conventional wick. The subject is listed for discussion at the next interstate explosives conference.

Mr. T. K. Wood has rendered efficient clerical and inspectional services, and likewise the Explosives Reserve staff have discharged their duties creditably. To the Naval, Army, Air and Police Force authorities the writer's gratitude is due for help and co-operation. The good fellowship extended by explosives interests continues at a high level, and the same may be said in regard to relationships with various Government departments and instrumentalities.

F. F. ALLSOP,
Chief Inspector of Explosives.

Division IX.

Report of Chairman, Miner's Phthisis Board, and Superintendent Mine Workers' Relief Act.

Under Secretary for Mines:

I have the honour to submit, for the information of the Honourable Minister for Mines, my report on this Branch of the Mines Department for the year, 1950.

Under arrangements similar to previous years, the Commonwealth Health Department continued the periodical examination of mine workers, the work being carried on continuously by the Health Laboratory at Kalgoorlie and by a mobile Laboratory which visits the mining centres in the various Goldfields. The Goldfields not visited during the year were the Ashburton, Gascoyne, Kimberley, West Kimberley, Pilbara and West Pilbara, which owing to their remoteness, being located North of the Tropic of Capricorn, are only visited biennially, and Phillips River, which contains very few mine workers.

Mine Workers' Relief Act.

The examinations under the Mine Workers' Relief Act during the year totalled 5,426, compared with 5,489 for the previous year, a decrease of 63. The results of the examinations for 1950 together with those for the previous years are shown in the Tables annexed hereto. A graph is is also attached illustrating the trend of the examinations since their inception in 1925. In explanation of these figures I desire to make the following comments.

Normal, etc.

These number 5,077 or 93.57 per cent. of the men examined, and include men having first-class lives, or suffering from Pneumoconiosis only, the figures for the previous year being 5,162 and 94.03 per cent.

Early Silicosis.

These number 283, of which 14 were new cases, and 269 had been reported previously, the figures for 1949 being 24 and 239 respectively. Early Silicotics represent 5.22 per cent. of the men examined, the percentage for the previous year being 4.79. The percentage of new cases was 0.26, compared with 0.44 for 1949.

Advanced Silicosis.

Of the 55 cases reported, 14 were men who advanced from Early Silicosis during the year, the other 41 having been previously reported. These include a number who are in receipt of compensation, and who were examined for Tuberculosis on behalf of the State Health Department, and strictly speaking should not be shown as having been examined under the Act. Advanced Silicotics represent 1.01 per cent. of the men examined, the percentage for the previous year being 0.93. The percentage of new cases was 0.26, compared with 0.36 for 1949.

Silicosis plus Tuberculosis.

Three cases were reported compared with six for the previous year and represents 0.05 per cent. of the men examined.

Tuberculosis Only.

Eight cases were reported, compared with seven for the previous year, and represent 0.15 per cent. of the men examined.

Aluminium Therapy.

Facilities for the introduction of Aluminium Therapy have now been installed on most of the big mines in the State and the process has been in operation on some of the Kalgoorlie mines for several months and is reported to be working satisfactorily.

General.

The new Mobile X-Ray Unit commenced operations about the middle of the year, and functioned quite satisfactorily, except for some few adjustments found to be necessary, and usually associated with any new plant.

Mines Regulation Act.

Examinations under the Mines Regulation Act totalled 2,955. This was in addition to the 5,426 examinations under the Mine Workers' Relief Act. These show an increase of 757 compared with the previous year.

The 2,955 men comprise, 2,221 new applicants and 734 re-examinees for the Initial Certificate.

Particulars of the examinations are as follows:—

New Applicants:—

Normal	1,971
Pneumoconiosis	15
Silicosis Early	2
Silicosis Advanced	—
Query Tuberculosis	79
Tuberculosis	2
Pneumoconiosis plus Query Tuberculosis	3
Other Conditions	149
	2,221

Of the above applicants for admission into the industry 1,971 received the Initial Certificate (Form 2), 38 received temporary Rejection Certificates (Form 3) and 212 received permanent Rejection Certificates (Form 4). Thus of 2,221 applicants, 1,971 or 88.77 per cent. were eligible for employment anywhere on a mine. Of those permanently rejected, and which included a large number of New Australians the percentage was 9.6%.

Re-examinations—

Normal	496
Pneumoconiosis	125
Silicosis Early	15
Silicosis Advanced	—
Query Tuberculosis	28
Tuberculosis	2
Pneumoconiosis plus Query Tuberculosis	8
Pneumoconiosis plus Tuberculosis	—
Silicosis Early plus Query Tuberculosis	—
Silicosis Early plus Tuberculosis	—
Silicosis Advanced plus Query Tuberculosis	—
Silicosis Advanced plus Tuberculosis	—
Other conditions	60
	734

These men had previously been examined and some were engaged in the industry prior to this examination. 496 received the Initial Certificate (Form 2), two received Temporary Rejection Certificates (Form 3), 20 received Rejection Certificates (Form 4), 61 received Re-Admission Certificates (Form 5) and 142 received Special Certificates (Form 9) and in 13 cases no certificate was issued. Thus of the 734 men examined 557 were eligible for employment anywhere on a mine, 142 were eligible for employment only on the surface and 35 were not eligible for any employment on a mine.

Grouping the two sets of figures discloses that the following certificates were issued under the Mines Regulation Act.

Initial Certificate Form 2	2,467
Temporary Rejection Certificate Form 3	40
Rejection Certificate Form 4	232
Re-Admission Certificate Form 5	61
Special Certificate Form 9	142
No Certificate	13
	2,955

The percentage of men of normal health to the number examined was 83 compared with 82 for the previous year.

Miner's Phthisis Act.

The amount of compensation paid during the year totalled £25,911 18s. 0d. compared with £27,482 1s. 0d. for the previous year, a decrease of £1,570 3s. 0d., attributable to the death of some of the beneficiaries and attainment of the age of 16 years by some of the dependent children.

The number of beneficiaries under the Act on the 30th December, 1950 was 228 being 27 ex-miners and 201 widows.

J. THOMAS,
Superintendent Mine Workers' Relief Act.

TABLE SHOWING RESULTS OF PERIODICAL EXAMINATION OF MINE WORKERS FROM INCEPTION OF EXAMINATIONS (1925).

Year of Examination.	Normal, etc.				Silicosis Early.					Silicosis Advanced.						Silicosis plus Tuberculosis.							Tuberculosis Only.				Total number of men Examined.
	Previously reported as Normal, etc.	New Cases.	Total.	Per cent.	Previously reported as Normal, etc.	Previously reported as Silicosis Early.	New Cases.	Total.	Per cent.	Previously reported as Normal, etc.	Previously reported as Silicosis Early.	Previously reported as Silicosis Advanced.	New Cases.	Total.	Per cent.	Previously reported as Normal, etc.	Previously reported as Silicosis Early.	Previously reported as Silicosis Advanced.	Previously reported as Silicosis, plus Tuberculosis.	New Cases.	Total.	Per cent.	Previously reported as Normal, etc.	New Cases.	Total.	Per cent.	
1925–1926	....	....	3,239	80·5	....	....	....	459	11·4	....	....	....	....	183	4·5	....	....	....	....	....	131	3·3	....	....	11	0·3	4,023
1927	2,290	826	3,116	83·6	....	348	33	381	10·2	....	....	85	8	93	2·5	13	27	62	....	26	128	3·4	....	....	10	0·3	3,728
1928	2,738	239	2,977	85·5	47	303	12	362	10·4	1	16	79	2	98	2·8	10	14	10	....	8	42	1·2	3	1	4	0·1	3,483
1929	2,099	21	2,120	81·9	100	224	2	326	12·6	....	34	60	....	94	3·6	8	14	19	....	....	41	1·6	7	....	7	0·3	2,588
1930	2,751	34	2,785	81·9	133	247	3	383	11·3	....	22	43	2	67	2·0	6	60	46	....	2	114	3·3	47	3	50	1·5	3,399
1931	2,530	....	2,530	84·0	94	252	....	346	11·5	....	18	35	....	53	1·8	4	35	19	....	....	58	1·9	25	....	25	8	3,012
1932	3,835	....	3,835	89·5	35	338	....	373	8·7	....	6	47	....	53	1·2	3	9	4	....	....	16	·4	8	....	8	·2	4,285
1933	2,920	....	2,920	86·5	57	322	....	379	11·2	1	15	44	....	60	1·8	2	9	4	....	....	15	·4	3	....	3	·1	3,377
1934	5,140	....	5,140	92·4	54	315	....	369	6·6	1	24	12	....	37	·7	6	6	....	....	....	12	·2	5	....	5	·1	5,563
1935	4,437	....	4,437	92·3	35	303	....	338	7·0	....	24	2	....	26	·6	....	5	....	....	....	5	·1	2	....	2	·0	4,808
1936	6,972	....	6,972	94·7	29	323	....	352	4·8	1	15	4	....	20	·3	3	8	....	....	....	11	·1	8	....	8	·1	7,363
1937	7,487	....	7,487	95·4	15	319	....	334	4·3	....	14	4	....	18	·2	1	10	....	....	....	11	·1	2	....	2	·0	7,852
1938	6,833	....	6,833	95·7	13	266	....	279	3·9	....	15	2	....	17	·2	1	8	....	....	....	9	·1	3	....	3	·0	7,141
1939	6,670	....	6,670	95·6	18	264	....	282	4·0	....	7	3	....	10	·1	1	9	1	....	....	11	·2	2	....	2	·0	6,975
1940	7,023	....	7,023	96·2	12	245	....	257	3·5	....	10	1	....	11	·2	....	4	....	....	....	4	·0	4	....	4	·0	7,299
1941	6,840	....	6,840	95·8	32	248	....	280	3·9	....	11	3	....	14	·2	....	....	....	....	....	....	....	7	....	7	·1	7,141
1942	5,469	....	5,469	93·9	61	264	....	325	5·6	....	20	5	....	25	·4	....	2	....	....	....	2	·0	3	....	3	·1	5,824
1943	3,932	....	3,932	91·5	63	262	....	325	7·6	....	25	7	....	32	·7	....	5	....	....	....	5	·1	4	....	4	·1	4,928
1944	4,079	....	4,079	91·5	70	270	....	340	7·5	....	21	14	....	35	·8	1	7	....	....	....	8	·2	6	....	6	·1	4,468
1945	3,071	....	3,071	92·1	54	166	....	220	6·6	....	26	10	....	36	1·1	3	2	....	....	....	5	·2	2	....	2	·1	3,334
1946	5,294	....	5,294	94·4	89	172	....	261	4·7	1	36	2	....	39	·7	3	1	2	....	....	6	·1	6	....	6	·1	5,606
1947	6,021	....	6,021	93·3	101	237	....	338	5·2	....	49	9	....	58	1·0	13	11	1	....	....	25	·3	8	....	8	·1	6,450
1948	4,827	....	4,827	94·0	24	239	....	263	5·1	....	18	17	....	35	·7	1	3	....	....	....	4	·1	5	....	5	·1	5,134
1949	5,162	....	5,162	94·0	24	239	....	263	4·8	....	20	31	....	51	1·0	3	2	....	1	....	6	·1	7	....	7	·1	5,489
1950	5,077	....	5,077	93·6	14	269	....	283	5·2	....	14	41	....	55	1·0	....	1	....	2	....	3	·1	8	....	8	·2	5,426

Division X.

Report of the Chief Coal Mining Engineer for the Year 1950.

The Under Secretary for Mines:

I have the honour to submit to the Hon. Minister for Mines the Annual Report on the operation of the Collie Coalfield for the year ended 31st December, 1950.

The aggregate output for the period under review was 814,498 tons, which is a record for the coalfield.

Details of the outputs of individual mines, manshifts worked and total value of coal sold are shown in Tables "A", "B" and "C" respectively.

In comparing the annual outputs of the individual mines, one must have regard to the periods of the annual holidays at the mines, as the time worked by each mine is not the same each year.

An examination of the production data reveals that although the aggregate output of deep mined coal is an increase of 12,165 tons, the percentage of deep mined coal in 1950 is 68.3% as compared with 72.5% in 1949—a decrease of 4.2%.

During 1949 there was a stoppage of work which accounted for a loss in output of 47,000 tons and, making allowance for this loss, the 1950 output, although a record, is little in excess of the 1949 output.

Comparing the aggregate of the deep mines, and having regard to the loss suffered during 1949, the rate of the deep mined output in 1950 is a substantial decrease on 1949.

This decline, in deep mined output, will continue in 1951 and 1952 unless the development work and re-organisation now in hand at some of the collieries is greatly intensified and accelerated.

The production from open cut mines in 1950 shows an increase of 51,867 tons as compared with 1949, and, as shown in Table "A", the total open cut coal produced in 1950 was 31.7% of the aggregate for the coalfield, as compared with 27.4% in 1949.

TABLE "A."

TABULATED DATA OF COAL SOLD IN 1950 FROM EACH INDIVIDUAL MINE COMPARED WITH 1949 AS REPORTED TO THE MINES DEPARTMENT.

Deep Mine.	1949.		1950.		Increase on 1949.	Decrease on 1949.
	Output.	Percent. Total.	Output.	Percent. Total.		
Co-operative	77,529	10·3	73,724	9·1	....	3,805
Proprietary	135,804	18·1	116,073	14·2	....	19,731
Cardiff	108,039	14·4	104,332	12·7	....	3,707
Stockton	86,866	11·6	93,012	11·4	6,146	....
Wyvern	64,956	8·7	94,277	11·6	29,321	....
Griffin	68,130	9·1	68,812	8·5	682	....
Phoenix	3,034	0·4	6,293	0·8	3,259	....
Total	544,358	72·5	556,523	68·3	12,165	....
Open Cut.						
Stockton	139,704	18·6	169,768	20·9	30,064	....
Black Diamond	66,404	8·8	83,258	10·2	16,854	....
Western Collieries	....	....	4,949	0·6	4,949	....
Total	206,108	27·4	257,975	31·7	51,867	....
Deep Mine	544,358	72·5	556,523	68·3	12,165	....
Open Cut	206,108	27·4	257,975	31·7	51,867	....
Grand Total	750,466	100·0	814,498	100·0	64,032	....

TABLE "B."

Table Showing :—

1. *Average Number of Men Employed at each Deep Mine and Percentage Each Category to Total Employed.*
2. *Manshifts actually worked during Year at each Deep Mine and Percentage each Category to Total Worked.*
3. *Output per Manshift in each Category.*

1950.

Name of Mine.	Face Workers.	Haulage.	Underground Maintenance.	Pump Attendants.	Officials.	Total Underground.	Total Surface.	Total Employed.
Griffin—								
No. of men employed	43	37	19	3	6	108	28	136
Percentage to Total Employed	31·4	27·0	13·8	2·2	4·4	79·5	20·5	100
Manshifts worked during year	11,014	10,072	5,433	1,306	2,040	29,865	8,632	38,497
Percentage Manshifts to total worked	28·61	26·16	14·11	3·39	5·29	77·56	22·44	100·00
O.M.S. in each category	6·24	6·83	12·65	52·61	33·24	2·30	7·97	1·79
Wyvern—								
No. of men employed	38	4	29	3	5	79	19	98
Percentage to Total Employed	38·80	4·10	29·6	3·07	5·12	80·69	19·31	100·00
Manshifts worked during year	10,598	846	8,251	1,296	1,653	22,644	5,733	28,377
Percentage Manshifts to total worked	37·35	2·98	29·07	4·57	5·83	79·80	20·20	100·00
O.M.S. in each category	8·9	111·4	11·42	72·44	57·0	4·16	16·44	3·32
Phoenix—								
No. of men employed	5	....	3	....	2	10	1	11
Percentage to Total Employed	45·45	....	27·27	....	18·18	....	9·10	100·00
Manshifts worked during year	1,401	....	762	....	612	2,775	78	2,853
Percentage Manshifts to total worked	49·10	....	26·71	....	21·45	97·26	2·74	100·00
O.M.S. in each category	4·49	....	8·25	....	10·28	2·27	80·68	2·20
Total Griffin Mines—								
No. of men employed	86	41	51	6	13	197	48	245
Percentage to Total Employed	35·10	16·73	20·82	2·45	5·31	80·41	19·59	100·00
Manshifts worked during year	23,013	10,918	14,446	2,602	4,305	55,284	14,443	69,727
Percentage Manshifts to total worked	33	15·66	20·72	3·73	6·17	79·28	20·72	100·00
O.M.S. in each category	7·36	15·51	11·72	65·10	39·34	3·06	11·72	2·43
Cardiff—								
No. of men employed	32	25	23	3	8	91	39	130
Percentage to Total Employed	24·6	19·2	17·7	2·3	6·2	70	30	100
Manshifts worked during year	8,176	6,318	7,027	1,215	2,807	25,543	10,571	36,114
Percentage Manshifts to total worked	22·6	17·5	19·4	3·4	7·8	70·7	29·3	100
O.M.S. in each category	12·8	16·5	14·8	85·9	37·2	4·1	9·8	2·88
Co-operative—								
No. of men employed	42	40	38	5	8	133	42	175
Percentage to Total Employed	24	22·9	21·7	2·8	4·6	76	24	100
Manshifts worked during year	9,838	10,727	11,089	2,039	2,815	36,508	11,878	48,386
Percentage Manshifts to total worked	20·33	22·17	22·92	4·21	5·82	75·45	24·55	100
O.M.S. in each category	7·49	6·87	6·65	36·15	9·43	2·02	6·21	1·52
Proprietary—								
No. of men employed	76	68	38	7	12	201	41	242
Percentage to Total Employed	31·4	28·1	15·8	2·9	4·9	83·1	16·9	100
Manshifts worked during year	16,883	17,864	11,698	2,859	3,748	53,052	10,621	63,673
Percentage Manshifts to total worked	26·4	28·1	18·4	4·5	5·9	83·3	16·7	100
O.M.S. in each category	6·9	6·5	9·9	40·6	31·0	2·2	10·9	1·82
Stockton—								
No. of men employed	49	29	16	3	7	104	28	132
Percentage to Total Employed	37·1	22·0	12·1	2·3	5·3	78·8	21·2	100
Manshifts worked during year	11,152	8,173	5,683	1,302	2,156	28,466	7,973	36,439
Percentage Manshifts to total worked	30·6	22·4	15·6	3·6	5·9	78·1	21·9	100
O.M.S. in each category	8·3	11·4	16·4	71·4	43·1	3·3	11·7	2·6

TABLE "B"—*continued.*

Name of Mine.	Face Workers.	Haulage.	Underground Maintenance.	Pump Attendants.	Officials.	Total Underground.	Total Surface.		Total Employed.
							Total Surface.	Central Workshops.	Total Employed.
Total Amalgamated Deep Mines—									
No. of men employed	199	162	115	18	35	529	150	70	749
Percentage to Total Employed	26·6	21·6	15·4	2·4	4·7	70·6	20	9·3	100
Manshifts worked during year	46,049	43,082	35,497	7,415	11,526	143,569	41,043	18,400	203,012
Percentage Manshifts to total worked	22·7	21·2	17·5	3·7	5·7	70·8	20·2	9·0	100
O.M.S. in each category	8·4	9·0	10·9	52·2	33·6	2·7	9·4	21	1·91
							Total Surface.		Total Employed.
Grand Total—Amalgamated and Griffin Deep Mines—									
No. of men employed	285	203	166	24	48	727	268		995
Percentage to Total Employed	28·6	20·4	16·7	2·4	4·8	73·1	26·9		100
Manshifts worked during year	69,062	54,000	49,943	10,017	15,831	198,853	73,886		272,739
Percentage Manshifts to total worked	25·3	19·8	18·3	3·7	5·8	72·9	27·1		100
O.M.S. in each category	8·06	12·6	11·1	55·6	35·2	2·8	7·5		2·04

TABLE C.

TABLE SHOWING TONNAGES AND ESTIMATED VALUES OF COAL PRODUCED FOR THE YEAR 1950.

(*As Reported to the Mines Department*).

Mine.	Tons.	Estimated Value.
		£A.
Co-operative	73,461	117,857
Proprietary	115,862	183,739
Cardiff	104,333	164,510
Stockton	93,013	148,553
Black Diamond Open Cut	83,450	134,000
Stockton Open Cut	169,870	272,900
Inferior Coal	40	39
Total—Amalgamated Collieries	640,029	1,021,598
Griffin	68,807	104,931
Wyvern	94,628	143,760
Phoenix	6,297	9,602
Total—Griffin Collieries	169,372	258,293
Collie Burn Open Cut	4,950	7,858
Total—Western Collieries	4,950	7,858
Grand Total	814,351	1,287,749

Here again, one must make allowance for the stoppage of work during 1949.

It is obvious that open cut coal must ultimately be replaced by deep mined and, to do so, it is equally obvious that an intensive programme of re-organization and mechanization must take place rapidly in the deep mines.

In this connection, there is no time to be lost as, otherwise, a very serious situation will arise in the near future with regard to deep mined coal.

The most significant feature during the year was the mechanisation of the Wyvern mine.

The programme of mechanisation was completed late in February and, considering the lack of experience of all concerned, the results obtained are very encouraging and illustrate the advantage of mechanisation.

It should be mentioned that to expect labour to handle efficiently modern coal mining equipment without previous training is not a policy that can be commended.

The operators of modern mining machinery should receive adequate training in its use, both on the surface and underground, and until the operator becomes proficient in the use of the machine he should not be put on to production.

It is realised that certain practical difficulties present themselves in implementing this policy but these difficulties must be overcome.

Early in December the Western Collieries Ltd. commenced production at their open cut mine at Collie Burn and an output of 4,949 tons was produced from this site.

The lease contains approximately 180,000 tons of coal and the Company anticipates, provided transport facilities exist, exhausting this source of supply early in 1952.

Loss of Output:

An examination of Table "D" shows that during 1950 a loss of output, due to all causes, of 45,917 tons was suffered as compared with 80,939 tons for 1949.

TABLE D.

COMPARISON OF OVERALL COAL PRODUCTION LOSSES FOR 1949 AND 1950 SHOWING WHERE LOSSES OCCURRED.

(*As Reported to the Mines Department*).

Year.	Pit Top Meetings.	Railway Wagon Shortage.	Strikes.	Other Causes.	Total.
1949	3,085	24,938	49,930	2,986	80,939
1950	3,927	31,933	135	9,922	45,917
Increase on 1949	842	6,995	....	6,936	....
Decrease on 1949	....	....	49,795	....	35,022

However, during 1949 a loss of 47,000 tons took place due to the stoppage of work in July of that year, so that, if allowance is made for this loss in 1949, the actual loss is 33,939 tons in 1949 as compared with 45,917 tons for 1950, of which 31,933 tons was assumed lost due to a shortage of wagons.

It should be stated that, of the total loss in output of 45,917 tons, no less than 31,237 tons is assumed lost at the open cut mines due to wagon shortage, but having regard to the relative positions of the overburden and coal face at both open

cut mines, it would be fair to state that if no stoppages had occurred due to a shortage of wagons, an enforced loss of output would have taken place due to the coal being loaded at a greater rate than it was exposed.

A very significant feature is that during 1950 comparatively no loss in output took place due to stoppages of work and, in this respect, both management and men are to be complimented.

The harmonious relations that at present prevail at Collie must be preserved and, if possible, improved—there are many directions in which this can be accomplished.

The greatest asset the companies possess is the goodwill of their employees, as it is on their performance one depends for improved efficiencies.

Development:

This is a matter of serious concern at Collie and is the most regrettable feature of the coalfield.

No mine, or coalfield, or any mineral field, can be said to have reached a stage of stability until the developments have reached a stage when output can be stabilised and maintained at a predetermined value.

This is not the case at Collie and, that being so, a programme of intensive development and reconstruction should be immediately planned for each mine as well as consideration for new mines.

The history of the coalfield, until recently, is one of perpetual financial embarrassment and, as a consequence, developments suffered, "long-term" planning was neglected and the industry today is consequently suffering from a severe handicap in this respect, and it is only by adopting a bold policy of re-organisation to overtake the lost position can the industry reach a stabilised and healthy position. This is a matter that should receive the urgent and immediate attention of the management.

The management have, in some instances, recognised this necessity and a programme of reorganisation, including mechanisation, is now progressing at the Cardiff, Co-operative and Proprietary mines and, to a lesser extent, at the Griffin mine. These developments need intensifying and accelerating as it will not be until developments are 5/10 years ahead of production and the output produced by mechanical means can any form of stability be achieved. The serious loss of output at the Wyvern mine during the latter part of the year is an example of lack of development.

The re-organisation of the Co-operative mine is worthy of note, and a plan of the re-organised workings accompany this report.

An examination of this plan reveals that the whole of the output is transported to the surface by belt conveyors, the coal being delivered to the belts through the medium of bunkers by large capacity skips and trolley-wire locomotives.

A unique feature of the re-organisation is the arrangement of the area into large blocks of coal which can be worked on the Selective Mining principle on the Retreating System. The quality of the coal as well as any geological disturbances are thus proved. The area is surveyed before production is commenced so that any dislocation of output due to the causes referred to is eliminated.

This system should be adopted throughout the whole coalfield.

In addition to underground re-organisation and mechanisation, an intensive programme of surface boring in the immediate vicinity of each mine should be adopted.

Underground explorations and developments at almost all the mines were retarded and, in many instances, stopped due to both major and minor faulting.

At Collie, the quickest and most economical method of proving these faults is by surface boring.

A programme of deep boring has been arranged and when this programme is complete the structure of the coalfield as a whole will be known, but the faults in the immediate vicinity of each mine will still remain not proved and long term planning will therefore be a hazardous undertaking at most of the mines and production will continue to be restricted and confined to isolated areas where conditions are known.

Considering the importance of Collie in the economics of the State, one cannot afford to take any such risks with the stability of a coalfield on which the State is dependent for its coal and prosperity.

It therefore seems that a programme of boring in the immediate vicinity of each mine, apart from the deep boring programme, is justified and urgently required, which, in conjunction with the driving of exploratory headings would obtain the necessary information for the long term planning of a predetermined and stabilised output.

An examination of Table "B" shows that of the total number of employees of 995, only 285 or 28.6% are employed on production or, if the manshifts worked are taken, only 25.3% of the total shifts worked were on production.

If an intensive programme of reconstruction and development had been in operation, one could readily appreciate the low proportion on production, but as such was not the case one can only attribute the reason for same as due to the high proportion of manshifts necessary on underground haulages and surface handling.

No useful purpose is served in labouring the inefficiencies of the haulage system. The statistics speak for themselves and illustrate the necessity for a complete reconstruction on mechanical principles.

The average O.M.S. for Amalgamated is only 1.91 tons, the Griffin Co. is higher at 2.43 tons, but both are very low considering the mining conditions—the average for the coalfield being only 2.04 tons.

This low O.M.S. cannot be regarded as an efficient or economical figure and, as previously stated, calls for an immediate policy of reconstruction and mechanisation to be put into immediate operation at each colliery.

It is realised that production must at least be maintained and means must be found to do so as well as reconstruct the mines.

Similar statistics to the above are not available for open cut mines as most of the work is performed by outside contractors who do not supply the Department with the particulars of the number of men employed and manshifts worked.

If priority is given to re-organisation and development and labour is taken off production for that purpose, then, unless more labour is imported to Collie, it will be necessary to consider another open cut in order to maintain output during the period that re-organisation is taking place, unless the output from existing open cuts can be considerably increased.

Comparison of Output of Deep Mined and Open Cut Coal.

Open cut mining commenced at Stockton in 1943 and since that date has extended to the Wallsend and Black Diamond.

The Wallsend leases were exhausted in 1948 after producing approximately 120,000 tons.

During the year the only open cuts in production were Stockton and Black Diamond. The Western Collieries open cut did not come into production until the middle of December.

It is interesting to compare the aggregate deep mined coal and open cut coal since the open cuts came into production in 1943.

Table "E" and Graph No. 1 illustrate the trend of output sold since that date.

An examination of the table and graph show a steady increase in the aggregate output since 1943,

In 1943 the aggregate output was 531,546 tons as compared with 814,498 tons for 1950, an increase of 282,952 tons or an increase of no less than 53.32 per cent. but during the same period the increase in deep mined coal was only 27,285 tons as compared with an increase of 255,667 tons in open cut coal.

The output of open cut coal will continue to increase during 1951, provided same is not adversely affected by inclement weather, due to the Western Collieries open cut at Collie Burn coming into production, but when the latter is exhausted, probably early in 1952, there will be a reduction in open cut output which must be replaced by deep mined coal.

One should have no apprehension in the matter provided the programmes of development, reorganisation and mechanisation are intensified and vigorously pursued in the deep mines. They should be in full production by that date, also the Western Collieries' deep mine should have commenced production, but, as already stated, the development and re-organisation programmes are matters of much concern and anxiety.

The need for rapid re-organisation and reconstruction is illustrated when one has regard to the fact that since 1942 approximately one hundred more men are now employed at the deep mines.

The output from the deep mines has during that time remained stationary, but had it not been for the Wyvern mine coming into production at the latter part of 1943 a considerable decrease in the aggregate deep mines output would have taken place. If regard is had for the increased aggregate output from deep mines due to the Wyvern coming into production, then a considerable decrease has taken place in all other deep mines.

TABLE E.

TABLE SHOWING TREND OF COAL OUTPUT SOLD SINCE 1943.

Open Cut Mines.	1943.	1944.	1945.	1946.	1947.	1948.	1949.	1950.
Stockton	2,308	66,779	111,951	120,853	97,318	112,289	139,704	169,768
Wallsend	Nil	Nil	Nil	31,221	54,381	35,014	Nil	Nil
Black Diamond	Nil	Nil	Nil	Nil	Nil	165	66,404	83,258
Western Collieries	Nil	Nil	Nil	Nil	Nil	Nil	Nil	4,949
Total Open Cut	2,308	66,779	111,951	152,074	151,699	147,468	206,108	257,975
Total Deep Mines	529,238	491,543	430,458	490,057	579,008	590,565	544,358	556,523
Aggregate All Mines	531,546	558,322	542,409	642,131	730,707	738,033	750,466	814,498
Percentage Open Cut to Aggregate	0·43	11·96	20·63	23·68	20·76	19·98	27·46	31·67
Percentage Deep Mines to Aggregate	99·57	88·04	79·37	76·32	79·24	80·02	72·54	68·33

Since 1942 all the mines are much further inbye and on account of the fact that the haulage systems, especially the subsidiary haulage, were not designed to cater for the long future, they are consequently inefficient and expensive in manpower. As the production faces continue to advance further inbye, and the haulage system becomes longer and more circuitous they will become still more inefficient; more men will be employed on same for less coal and the cost of operating will become prohibitive.

There is no method of rehabilitating most of the haulage systems and the only means possible of providing efficient systems is to commence areas in each mine or new seams, and provide same with modern systems of haulage, such as belt conveyors or locomotives; perferably the latter with large capacity mine cars.

Apportionment of Coal Sold During 1950 as Compared with 1949.

The apportionment of coal sold during the years 1949 and 1950 is shown on the tabulations appended to this report as Tables "F" and "G."

During 1950, the Railways and S.E.C. consumed 371,510 tons and 308,466 tons respectively, a total of 679,956 tons or 83. 4 per cent. of the total coal sold as compared with 356,118 tons and 290,065 tons respectively in 1949, a total of 646,183 tons or 86 per cent. of the total coal sold.

Private consumers purchased in 1950, 24,902 tons Smalls and 67,948 tons Large—a total of 92,850 tons or 11.4 per cent. of the total coal sold as compared with 20,295 tons Smalls and 46,468 tons Large—a total of 66,763 tons or 8.9 per cent. of the total coal sold in 1949.

Therefore, in 1950, private consumers purchased 26,087 tons more than in 1949, an increase of 39 per cent.

It is interesting and perhaps instructive to record the trend of private consumption.

The consumption of "Small Coal" in 1950 was 24,902 tons as compared with 20,295 tons in 1949, an increase of 4,607 tons or 22.7 per cent.

The consumption of "Large Coal" in 1950 was 67,948 tons as compared with 46.468 tons in 1949 an increase of 21,480 tons or 46.2 per cent. on the 1949 consumption.

TABLE F.

TABULATION SHOWING APPORTIONMENT OF COAL SOLD DURING THE YEAR 1949.

As Reported to the Mines Department Weekly.

Colliery.	Loco.	%	Trams.	%	Private Small.	%	Private Large.	%	Cement Works.	%	Collie Power House.	%	Total Sold.
Co-operative .... Black Diamond O/C.	88,834	61·718	32,676	22·702	....	....	32	·022	366	·255	22,025	15·303	143,933
Proprietary	77,904	57·365	13,152	9·684	4,223	3·110	20,915	15·401	19,549	14·395	61	·045	135,804
Cardiff	....	....	89,030	82·405	1,761	1·630	1,553	1·438	15,641	14·477	54	·050	108,039
Stockton .... Stockton O/C.	150,428	66·394	70,756	31·229	8	·004	3,264	1·441	1,964	·866	150	·066	226,570
Griffin	19,439	28·533	13,598	19·958	14,303	20·994	20,704	30·389	....	....	86	·126	68,130
Wyvern	19,513	30·040	43,812	67·449	....	....	....	....	....	....	1,631	2·511	64,956
Phoenix	....	....	3,006	99·077	....	....	....	....	....	....	28	·923	3,034
Total	356,118	47·453	266,030	35·449	20,295	2·704	46,468	6·192	37,520	5·000	24,035	3·202	750,466

TABLE G.

TABULATION SHOWING APPORTIONMENT OF COAL SOLD DURING THE YEAR 1950.

As Reported to the Mines Department Weekly.

Colliery.	Loco.	%	Trams.	%	Private Small.	%	Private Large.	%	Cement Works.	%	Collie Power House.	%	Total Sold.
Co-operative .... Black Diamond O/C.	101,607	64·725	52,425	33·395	795	·506	1,056	·673	555	·355	544	·346	156,982
Proprietary	61,718	53·172	3,059	2·635	3,351	2·887	20,154	17·363	7,295	6·285	20,496	17·658	116,073
Cardiff	1,148	1·100	61,221	58·679	1,986	1·904	9,553	9·156	28,928	27·727	1,496	1·434	104,332
Stockton .... Stockton O/C.	154,445	58·773	87,314	33·227	491	·187	13,785	5·246	4,914	1·870	1,831	·697	262,780
Griffin	17,691	25·709	15,099	21·943	11,253	16·353	23,028	33·465	....	....	1,741	2·530	68,812
Wyvern	31,843	33·776	48,954	51·926	7,026	7·453	274	·290	....	....	6,180	6·555	94,277
Phoenix	....	....	6,195	98·443	....	....	98	1·557	....	....	....	....	6,291
Western Collieries	3,058	61·790	1,891	38·210	....	....	....	....	....	....	....	....	4,949
Total	371,510	45·612	276,158	33·905	24,902	3·058	67,948	8·342	41,692	5·119	32,288	3·964	814,498

It therefore appears that as the demand by private consumers increases it will mostly be for large coal.

It is probable that the increase in consumption of large coal by private consumers is due to the fact that the larger sized coal is cleaner, as most of the extraneous dirt is contained in the smaller sizes.

If this assumption is correct, then the need for cleaning the smaller sizes is apparent.

It is probable that the coal consumed by Government instrumentalities has reached saturation point for the immediate future. In fact, when the South Fremantle Power Station comes into operation, the consumption by the S.E.C. will decrease for the immediate future but will probably increase again later as new industries come into operation demanding more power.

In the meantime, private consumers must be encouraged to use coal as their fuel.

The number of such consumers is increasing rapidly and every encouragement must be given them by supplying good clean coal.

As previously stated, private consumers purchased in 1950, 92,850 tons or 11.4 per cent. of the total amount sold but the requirements of private consumers far exceeded this amount.

The policy of the management in the past and, in fact, at present is to "dig it and sell it," no attempt being made to thoroughly clean it, with the result that it is not the best product which is commercialised. Every effort should be made to supply consumers with coal of a guaranteed ash content or calorific value, preferably the latter.

In a competitive market the coal must be properly prepared by cleaning the "run of mine" coal by mechanical means.

To design a suitable plant for coal cleaning, especially for Collie coal where each seam has different characteristics, is a difficult problem requiring much research.

The Government Chemical Laboratories are actively engaged in the research work and it is hoped, as a result of these researches that a suitable cleaning plant can be designed and will be installed at Collie.

Accidents.

The total number of serious accidents in 1950 was 141 as compared with 175 for the previous year, a decrease of 34 or 24.1 per cent. in spite of more time worked during 1950.

Table "H" shows the number of serious accidents at each individual mine and Table "I" shows details of the nature of the injury sustained.

In order to compare the incidence of the accidents at each mine, the rate per 100 men employed, per 100,000 tons produced and per 10,000 manshifts worked is shown, not including the two accidents which took place at the Black Diamond Open Cut.

The rate of serious accidents seems to be phenomenally high and difficult to explain.

It is not possible to compare the rate of accidents at Collie with the accidents in other States, as statistics are not available for the latter.

The greatest number of accidents at Collie occur on the haulage roads due, probably, to the antiquated haulage system and especially to the customary practice of persons travelling on haulage roads whilst the haulage is in motion—a practice that is to be deplored.

It appears that the use of protective equipment would tend to reduce many causes of accidents at the coal face.

There was only one fatal accident during the year which was due to a wheeler being trapped between skips and a centre prop on a flat.

The use of centre props is to be deplored and they should be eliminated wherever possible.

An examination of the fatal accident rate—as per table "J"—shows a progressively decreasing rate per 1,000 persons employed, and since 1929 it has decreased from 4.66 per 1,000 to 0.91 in 1950.

No comparison with other States is possible as statistics are not available but one can look forward with confidence to a substantial reduction in all accident rates when the mines are fully mechanised.

TABLE H.

ACCIDENT RATE FOR INDIVIDUAL MINES (NOT INCLUDING CENTRAL WORKSHOPS AND OPEN CUTS).

Serious Accidents.

Name of Mine.	Number of Accidents.		Total 1950.	Number Employed.	Rate per 100 men employed.	Rate per 100,000 tons produced.	Rate per 10,000 manshifts worked
	Surface.	Underground					
Cardiff	1	18	19	130	14·6	18·21	5·26
Co-operative	3	16	19	175	10·8	25·77	3·93
Proprietary	7	37	44	242	18·18	37·90	6·91
Stockton	4	20	24	132	18·18	25·80	6·58
Griffin	2	18	20	137	14·6	29·06	5·19
Wyvern	2	11	13	98	13·26	13·79	4·58
Phoenix	....	....	....	11	....	....	....
Total Deep Mines	19	120	139	925	15·02	25·00	5·46

TABLE "I."

SERIOUS ACCIDENTS—COLLIE COALFIELD.

	Major Injuries—Exclusive of Fatal.																					Minor Injuries.												
	Fractures.										Amputations.											Fractures.												
Month 1950.	Head.	Shoulder.	Arm.	Hand.	Spine.	Rib.	Pelvis	Thigh.	Leg.	Ankle.	Foot.	Arm.	Hand.	Finger.	Leg.	Foot.	Toe.	Loss of Eye.	Serious Internal.	Hernia.	Dislocation.	Other Major.	Total Major.	Finger.	Toe.	Head.	Eyes.	Shoulder.	Arm.	Hand.	Back.	Rib.	Leg.	Foot.	Other Minor.	Total Minor.
Jan.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1	1	1	1	....	1	....	3	9
Feb.	....	....	....	....	....	....	....	....	....	....	1	....	....	1	....	....	....	....	....	....	....	....	2	1	1	....	1	1	1	2	2	....	1	3	2	15
Mar.	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1	....	....	2	1	....	....	....	2	....	1	....	....	2	1	....	7
April	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	2	....	1	....	3	6
May	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	1	2	....	....	....	2	1	2	....	5	3	1	17
June	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	2	1	....	....	....	....	....	2	....	3	....	1	9
July	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	1	1	....	1	....	1	....	4	2	1	3	....	2	15
Aug.	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	2	....	....	....	....	1	2	2	....	1	2	....	3	11
Sept.	....	....	....	....	....	1	....	1	1	....	....	....	....	1	....	....	....	....	....	....	....	....	4	....	....	....	....	1	....	4	....	....	....	4	2	11
Oct.	....	....	1	....	....	2	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1	5	....	....	....	....	1	....	1	1	....	3	....	1	7
Nov.	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	1	....	....	....	3	3	....	1	....	1	9
Dec.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	1	....	....	....	....	....	....	....	....	....	2	1	....	4
Total	....	....	2	1	....	4	....	1	1	1	3	....	....	2	....	....	....	....	....	4	....	2	21	7	4	2	1	8	6	19	16	2	24	12	19	120

TABLE J.

TABLE SHOWING FATAL ACCIDENT RATE PER 1,000 PERSONS EMPLOYED FOR EACH YEAR AND PROGRESSIVELY SINCE 1929 TO 1950.

Year.	Men Employed.		Fatal Accident.		Death Rate per 1,000.	
	Current.	Progressive.	Current.	Progressive.	Current.	Progressive.
1929	858	858	4	4	4·66	4·66
1930	898	1,754	....	4	....	2·28
1931	752	2,506	1	5	1·33	2·00
1932	604	3,110	....	5	....	1·61
1933	626	3,736	1	6	1·59	1·61
1934	624	4,360	....	6	....	1·38
1935	689	5,049	2	8	2·90	1·58
1936	768	5,817	....	8	....	1·37
1937	723	6,540	....	8	....	1·22
1938	765	7,305	1	9	1·31	1·23
1939	752	8,057	1	10	1·33	1·24
1940	713	8,770	3	13	4·21	1·48
1941	781	9,551	2	15	2·56	1·57
1942	822	10,373	2	17	2·43	1·64
1943	838	11,211	1	18	1·19	1·60
1944	880	12,091	1	19	1·13	1·57
1945	860	12,951	1	20	1·16	1·54
1946	955	13,906	1	21	1·05	1·51
1947	1,032	14,938	....	21	....	1·40
1948	1,064	16,002	....	21	....	1·31
1949	1,044	17,046	1	22	0·96	1·29
1950	1,099	18,145	1	23	0·91	1·27

Staff:

Mr. J. Gillespie, Senior Inspector of Mines, was granted eight weeks' sick leave from 30/3/50 to 7/6/50.

During his absence his duties were ably performed by Mr. J. Faulds who was temporarily appointed for six months as a Special Inspector.

On 16/11/50 Mr. Faulds was permanently appointed to assist Mr. Gillespie.

One regrets to record the sudden death on 28/3/50 of Mr. B. McCabe who was Workmen's Inspector.

Mr. McCabe had occupied this position since 19/7/48 and during that time carried out his duties very efficiently. His loss was deeply felt by all concerned.

The duties of Workmen's Inspector were temporarily performed by Mr. F. J. Newburn, pending a permanent appointment.

A ballot was held on 31/5/50, there being three candidates for the position, and Mr. C. D. Henderson was elected.

Mr. Henderson commenced his duties on 12/6/50 and has very ably carried out his various duties of Workmen's Inspector.

I would like to record my appreciation to all members of the Department who have been given devoted and loyal service to the Department during the year.

G. MORGAN,
Chief Coal Mining Engineer.

COAL MINES REGULATION ACT, 1946.

Annual Report of the Board of Examiners for Mine Managers, under Managers and Deputies.

Office of the Chief Coal Mining Engineer.

Mines Department, Perth.

13th March, 1951.

The Under Secretary for Mines:

We submit herewith, for the information of the Hon. Minister for Mines, the Annual Report of the Board of Examiners for the year 1950.

May Examination: As there was only one applicant for the examinations to have been held at Collie on 17th, 18th and 19th May, the examinations were cancelled.

October Examination: There were no candidates for the First Class Certificate of Competency examination.

Two candidates sat for the Second Class Certificate of Competency as Under Managers, of whom one passed and received his Certificate.

Eight applications were received for the Third Class Certificate of Competency examination. Seven only sat for the examination, five of whom were successful and were issued with Certificates accordingly.

The following is the list of successful candidates:—

Second Class Certificate of Competency as Under Manager:

Montgomery, T. O.

Third Class Certificate of Competency as Deputy:

Carter, H. W.
Fewster, K.
Filsell, E.
Fogarty, A. T.
Slater, G.

First Class Reciprocal Certificates of Competency were granted to the following:—

Mr. T. O. Croudace—Holder of a First Class Certificate of Competency granted in New South Wales.

Mr. W. R. H. S. Rowe—Holder of a First Class Certificate of Competency granted in New South Wales.

Mr. J. W. Glendenning—Holder of a First Class Certificate of Competency issued in New Zealand and endorsed and registered in New South Wales.

Mr. J. Adamson—Holder of a First Class Certificate of Competency issued in New Zealand.

An application was also received for a Reciprocal Third Class Certificate of Competency, but since the Act does not provide for the granting of such a certificate, the application was refused.

The Board would respectfully draw the attention of the Minister to the fact that no facilities for technical training in Mining subjects are at present available at Collie for the lower grades of Mines officials or at Perth for the higher grades of Mines officials.

If suitable arrangements could be made for such training, we are satisfied that same would be of great benefit to the coal mining industry.

G. MORGAN,
Chief Coal Mining Engineer, Chairman.

H. A. ELLIS,
Government Geologist, Member.

JAMES GILLESPIE,
Senior Inspector of Mines, Collie, Member.

ANNUAL REPORT OF THE COAL MINES ADVISORY BOARD.

Office of the Chief Coal Mining Engineer,
Mines Department,
Perth, 13th March, 1951.

The Under Secretary for Mines:

We submit herewith, for the information of the Hon. Minister for Mines, the Annual Report of the Coal Mines Advisory Board for the year 1950.

The Board was appointed in December, 1949, in accordance with Section 4 of an Act to Amend the Mining Act, 1904/45, No. 84 of 1948.

Members of the Board are Mr. G. Morgan, Chief Coal Mining Engineer (Chairman) and Messrs. H. S. Rowe, Assistant Superintendent, Amalgamated Collieries of W.A. Ltd., and F. J. Newburn (Members).

During the year, twelve meetings have been held and, in addition, frequent underground and surface inspections have been made. In addition to these inspections, I have personally made numerous other underground and surface inspections.

Many matters of vital importance to the industry have been discussed, such as Long Term Planning, Re-organization, Mechanization, Training of Personnel, Technical Training for Students, Preparation of coal for the market.

As a result of these discussions, much clarification on the matters mentioned has been achieved and some progress made, such as arrangements for boring in the immediate vicinity of the Proprietary, Wyvern and Stockton mines.

The result of these borings will enable these collieries to proceed with re-organization and long term planning.

The need for some form of coal preparation plant was discussed at some length and it was realised that considerable research was necessary and, as a consequence, the Director of the Government Chemical Laboratories arranged for a "field laboratory" at Collie with a full time chemist in charge to carry out the necessary research work.

The question of training new entrants to the industry has been discussed at some length and all members of the Board agree on the principle of submitting all new entrants to some form of training in the basic principles of mining prior to being given a full time job either on the surface or underground. Also, the question of technical training for persons desiring to become deputies, undermanagers, surveyors and electricians has been discussed.

At present there are no facilities for such training and any person desiring promotion must study privately. The result is that the standard of technical knowledge is comparatively low.

There is no reason why any of the employees should not have the opportunity of obtaining the necessary technical training needed for the higher positions.

This can only be achieved by instituting a technical school for the purpose and it is hoped that the education authorities will arrange a mining course for Deputies in the new technical school now under construction at Collie.

The Board considers that the training of new entrants and the technical training of mining students is of paramount importance for the future of the Collie coalfield.

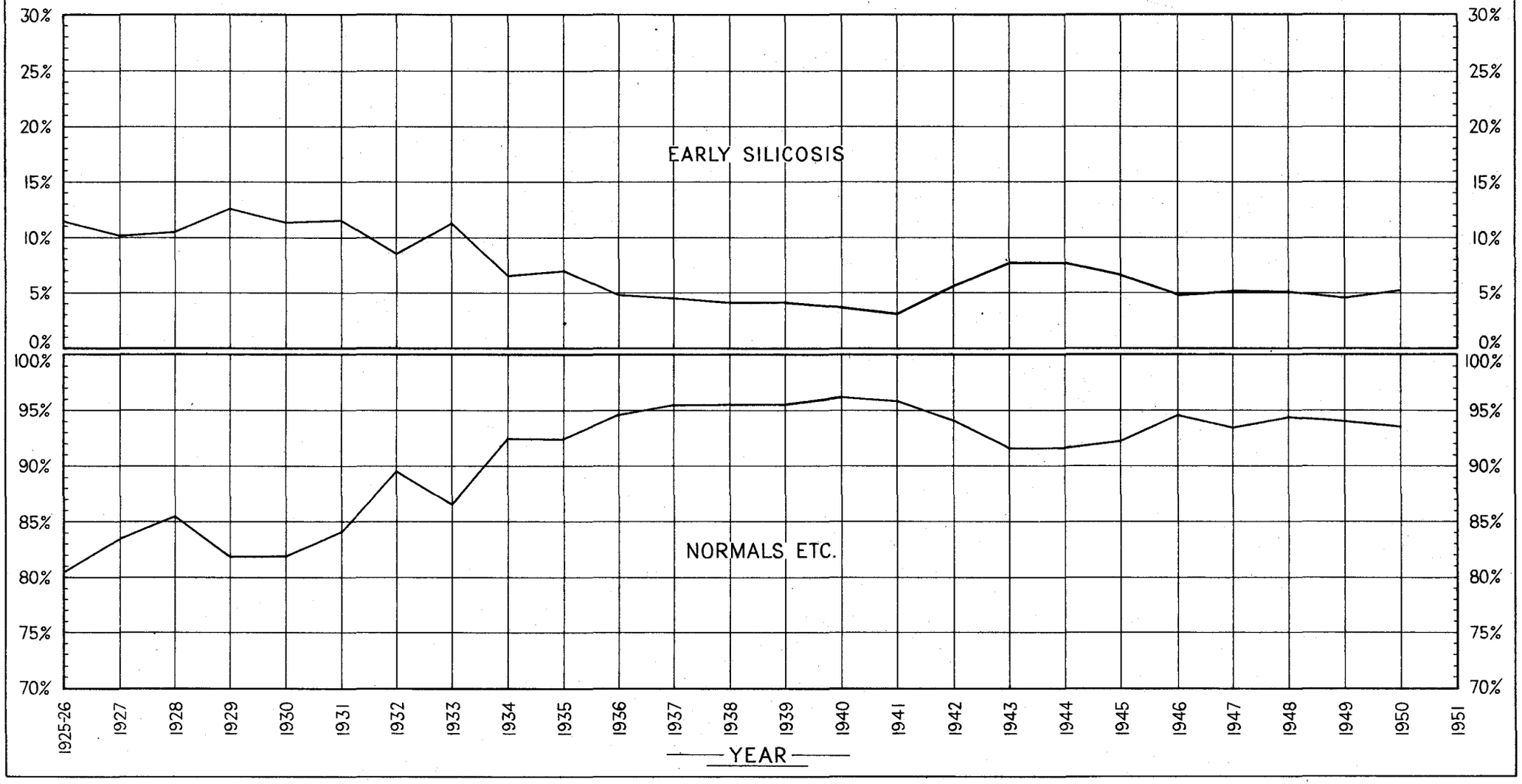
During the coming year such matters as Hydraulic Stowing, Pneumatic Transport of coal as well as underground gasification of pillar coal and the recovery of some pillar coal by Auger mining will be discussed. Attention will also be given to a manpower survey of the field and to other matters towards maintaining coal production for the next five years.

G. MORGAN,
Chief Coal Mining Engineer.

PERIODICAL EXAMINATION OF MINE WORKERS

GRAPH No.1

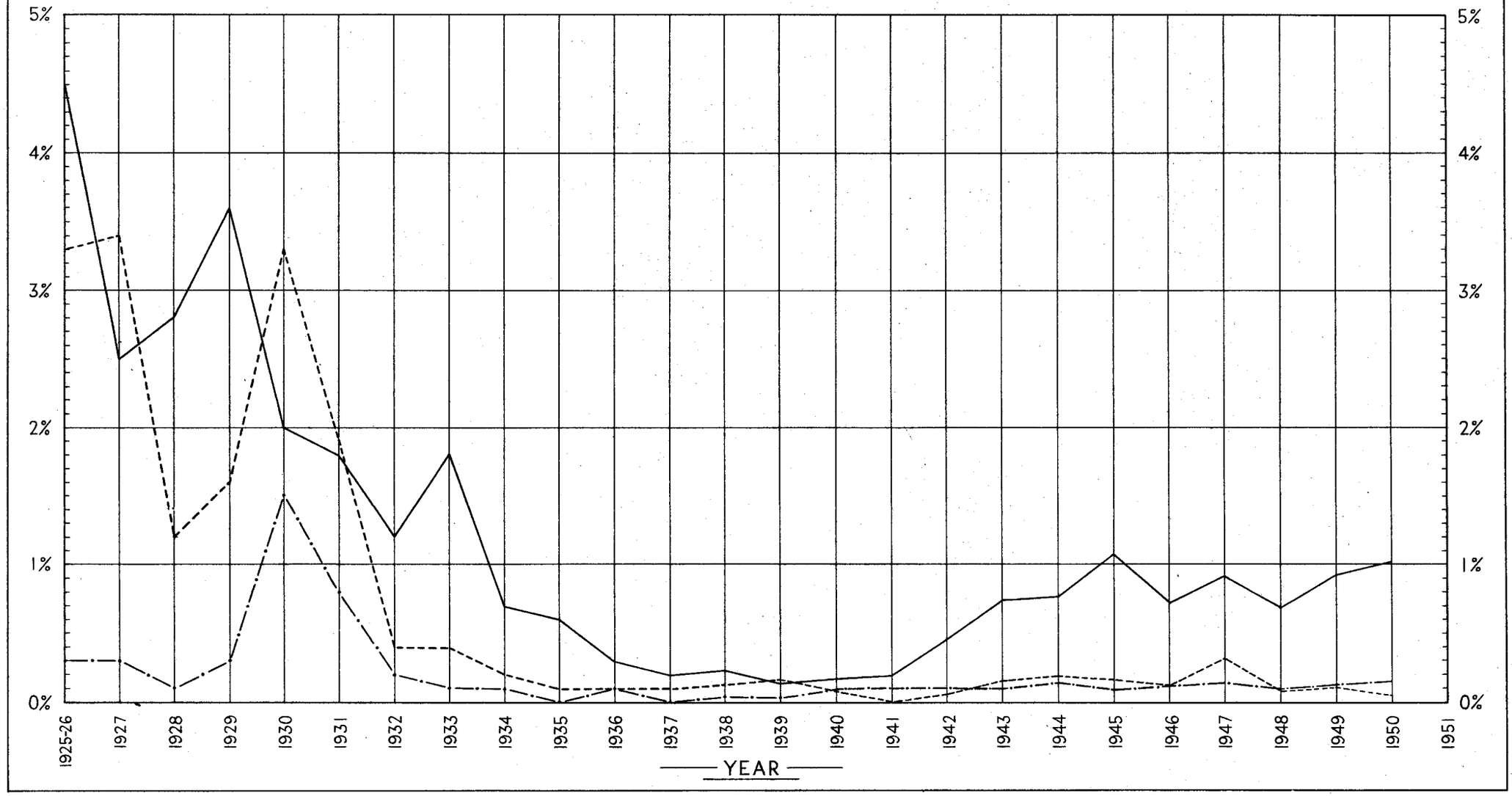
Showing Percentages of Normals and Early Silicotics, from 1925-26 onwards



PERIODICAL EXAMINATION OF MINE WORKERS

GRAPH No. 2

Showing Percentages of Silicosis Advanced, Silicosis plus Tuberculosis and Tuberculosis only, from 1925-26 onwards



Silicosis Advanced ———— *Silicosis Plus Tuberculosis* - - - - - - - - *Tuberculosis Only* —·—·—·—

Mining Statistics to 31st December, 1950.

TABLE OF CONTENTS.

TABLE I.

PRODUCTION OF GOLD AND SILVER FROM ALL SOURCES, SHOWING IN FINE OUNCES THE OUTPUT AS REPORTED TO THE MINES DEPARTMENT DURING 1950, AND THE TOTAL PRODUCTION TO DATE.

(Note.—Lease numbers in brackets indicate that the holding was *voided* during the year.)

(Note.—* denotes mainly derived from treatment of tailings.)

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Kimberley Goldfield.												
Brockman	109	Mt. Bradley	....	....	....	....	....	....	....	193·00	50·94	....
		Voided leases	....	....	....	....	....	....	....	1,352·75	1,404·40	....
		Sundry claims	....	....	....	....	....	7·62	7·62	2,484·00	1,871·92	....
Halls Creek	....	Voided leases	....	....	....	....	....	....	....	423·00	477·76	....
		Sundry claims	....	....	....	....	....	27·73	....	204·55	159·68	12·64
Mary River	119	New Look	82·66	951·52	....	....	....	82·66	951·52	....	....	....
		Voided leases	....	....	....	....	....	....	....	399·00	210·03	....
		Sundry claims	....	14·36	....	....	....	....	14·36	46·85	53·66	....
Mt. Dockrell	95	Irish Lass	....	....	....	....	....	9·17	13·66	341·00	266·75	....
		Voided leases	....	....	....	....	....	....	....	832·70	939·34	93·00
		Sundry claims	....	....	....	....	....	18·89	31·31	160·00	89·64	....
Panton	114	Granite Lease	....	....	....	....	....	....	....	8·25	1·77	....
		Voided leases	....	....	....	....	....	....	....	34·70	138·70	....
		Sundry claims	....	....	....	....	....	....	....	6·15	18·01	....
Ruby Creek	98	Goliath	....	....	....	....	....	....	....	120·70	103·72	....
	97	Ruby Queen	....	....	....	....	....	....	....	2,919·25	1,631·30	2·14
	100	St. Lawrence	....	....	....	....	....	....	....	10·00	11·32	....
		Voided leases	....	....	....	....	....	....	16·05	12,771·50	9,504·78	....
		Sundry claims	....	....	....	....	....	12·71	....	281·25	183·30	....
		From Goldfield generally :										
		Sundry claims	....	....	....	....	....	....	....	....	....	5·90
		Reported by Banks and Gold Dealers	35·68	157·00	....	....	....	8,470·27	996·10	·75	1·54	....
		Totals	**118·34**	**1,122·88**	....	....	....	**8,629·05**	**2,030·62**	**22,589·40**	**17,118·56**	**113·68**
West Kimberley Goldfield.												
Napier Range	M.C. 29	Devonian Silver Lead Mine	....	....	....	....	48·15	....	....	....	....	5,002·02
Mt. Broome	....	Sundry claims	....	....	....	....	....	....	13·76	....	....	....

Richenda	....	Sundry claims	....	....	....	....	....	....	....	....	1·00	2·49	....
		From Goldfield generally :											
		Reported by Banks and Gold Dealers	....	....	....	....	....	1·30	10·92	....	....	....
		Totals	....	....	....	....	**48·15**	**1·30**	**24·68**	**1·00**	**2·49**	**5,002·02**

West Pilbara Goldfield.

Croydon	....	Voided leases	....	....	....	....	....	....	....	....	8·00	5·44	....
Hong Kong	....	Voided leases	....	....	....	....	....	....	....	....	331·00	442·45	....
		Sundry claims	....	....	....	....	....	21·40	·02	9·00	3·15	....
Lower Nicol	....	Voided leases	....	....	....	....	....	....	1·10	653·20	402·22	....
		Sundry claims	....	....	....	....	....	10·44	2·71	10·00	11·51	....
Mallina	....	Voided leases	....	....	....	....	....	....	....	141·60	128·44	....
Nicol	....	Voided leases	....	....	....	....	....	....	....	30·00	11·47	....
Pilbara	....	Voided leases	....	....	....	....	....	....	48·12	267·00	413·59	....
		Sundry claims	....	....	....	....	....	1·11	86·24	163·00	255·42	....
Roebourne	173, 174	Corderoy Mines, Ltd.	....	....	....	*13·12	....	....	....	1,954·50	471·13	10·79
		Voided leases	....	....	....	....	....	....	....	442·36	952·91	374·66
		Sundry claims	....	....	....	....	....	15·47	3·29	1,934·85	754·91	114·06
Station Peak	176	Nancy	....	....	35·00	19·64	....	....	....	35·00	19·64	....
		Voided leases	....	....	....	....	....	177·74	41·37	10,936·00	11,347·42	....
		Sundry claims	....	....	49·00	29·04	....	....	....	86·50	77·23	....
Towranna	....	Voided leases	....	....	....	....	....	....	2·62	3,965·80	5,187·51	....
		Sundry claims	....	....	....	....	....	....	....	22·00	12·35	....
Upper Nicol	....	Sundry claims	....	....	....	....	....	....	....	6·50	2·57	....
Weerianna	....	Voided leases	....	....	....	....	....	....	....	3,200·15	3,214·45	....
		Sundry claims	....	....	93·00	53·36	....	....	....	336·00	135·26	1·29
Whim Creek	....	Voided leases	....	....	....	....	....	....	....	....	....	883·80
		From Goldfield generally :										
		Sundry claims and leases	....	....	....	....	25·52	....	....	....	....	69·60
		Sundry Parcels treated at various Works	....	....	....	....	....	....	....	....	102·39	4·90
		Reported by Banks and Gold Dealers	....	....	....	....	....	6,086·74	170·45	103·50	228·32	·11
		Totals	....	....	**177·00**	**115·16**	**25·52**	**6,312·90**	**355·92**	**24,635·96**	**24,179·78**	**1,458·91**

Table I.—*Production of Gold and Silver from all sources*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Pilbara Goldfield.												
MARBLE BAR DISTRICT.												
Bamboo Creek	1107	Bulletin	....	....	51·50	39·10	....	....	....	51·50	39·10	....
	850	Federation	....	....	471·00	256·18	·10	....	8·22	2,434·00	1,848·44	·10
	707	Kitchener	....	....	80·50	18·26	....	....	....	10,094·00	13,475·05	·75
	1010	Mickey	....	....	27·00	4·46	·34	....	....	1,741·00	467·59	1·42
	1096	Mt. Prophecy	....	....	443·00	155·97	9·95	....	....	443·00	155·97	9·95
	817	Prince Charlie	....	....	390·00	129·08	18·88	....	3·68	3,530·00	3,487·76	52·29
	1075	Queen	....	....	21·00	3·08	....	....	....	241·00	150·03	....
	924	True Blue	....	....	....	....	....	....	....	2,093·25	85·22	....
		Voided leases	....	....	....	....	....	13·54	560·19	33,919·35	38,705·23	....
		Sundry claims	....	....	72·00	11·36	·39	8·97	307·83	5,095·85	2,999·42	4·89
Boodalyerrie	....	Voided leases	....	....	....	....	....	....	292·07	120·25	587·86	....
		Sundry claims	....	....	....	....	....	....	7·16	....	....	....
Braeside	....	Sundry claims	....	....	....	....	1,217·70	....	....	....	....	1,874·94
Lalla Rookh	....	Voided leases	....	....	....	....	....	....	4·78	3,612·00	4,696·33	574·01
		Sundry claims	....	....	....	....	....	....	....	7,943·00	7,675·09	....
Marble Bar	1094	Blue Bar	....	....	129·00	22·25	....	....	....	129·00	22·25	....
	927, etc.	Comet Gold Mines, Ltd.	....	....	3,525·00	2,093·46	63·65	....	....	114,466·44	103,138·15	214·82
	927, etc.	Prior to transfer to present holders	....	....	....	....	....	....	....	2,195·75	1,235·42	....
	912	Homeward Bound	....	....	....	....	....	....	....	6,292·25	3,111·75	....
	1054	Illareen	....	....	....	....	....	....	....	40·00	6·32	·36
	1089	Repeater	....	....	....	....	....	....	....	548·20	123·83	6·26
		Voided leases	....	....	....	....	....	....	199·09	40,460·55	40,719·73	·83
		Sundry claims	....	....	98·00	75·45	5·66	67·08	251·77	19,886·29	12,522·07	6·59
North Pole	1040	Australian Mining and Industrial Finance Pty., Ltd.	....	....	2,022·00	770·79	215·65	....	....	2,247·00	842·83	260·08
	1040	Prior to transfer to present holders	....	....	....	....	....	....	....	69·00	31·07	....
		Voided leases	....	....	....	....	....	....	....	548·00	400·52	....
		Sundry claims	....	....	120·00	12·24	15·82	....	....	669·75	298·62	15·82
North Shaw	....	Voided leases	....	....	....	....	....	7·53	....	1,072·45	996·29	....
		Sundry claims	....	....	....	....	....	2·84	567·06	179·75	121·72	....
Pilgangoora	....	Voided leases	....	....	....	....	....	16·65	....	2,255·00	403·60	....
		Sundry claims	....	....	....	....	....	161·08	8·13	481·60	146·39	....

Sharks	1108	Edith Mae	....	....	18·75	18·57	1·16	....	....	18·75	18·57	1·16
	1081, etc.	Table Top Leases	....	....	83·25	37·03	10·39	....	....	237·25	120·02	14·08
		Voided leases	....	....	....	....	....	1·43	....	1,720·75	1,951·08	....
		Sundry claims	....	....	22·00	16·90	....	163·14	47·93	1,150·75	1,668·11	·97
Talga Talga	....	Voided leases	....	....	....	....	....	....	93·15	1,799·00	1,760·68	....
		Sundry claims	....	....	....	....	....	76·17	85·18	1,975·90	1,499·86	·70
Tambourah	....	Voided leases	....	....	....	....	....	....	73·90	1,576·50	1,882·29	....
		Sundry claims	....	....	....	....	....	89·52	294·75	3,742·25	2,689·78	....
Warrawoona	1087	Town Talk	....	....	....	....	....	....	....	300·45	127·91	13·34
	1013	Trump	....	....	351·25	23·23	1·69	....	....	3,380·05	582·04	9·91
		Voided leases	....	....	....	....	....	....	16·99	12,748·80	18,830·50	....
		Sundry claims	....	....	13·00	6·69	....	70·98	623·67	6,632·79	4,247·38	·08
Western Shaw	....	Voided leases	....	....	....	....	....	....	....	1,222·50	957·80	....
		Sundry claims	....	....	....	....	....	22·34	67·47	71·50	81·49	....
Wyman's Well	1084	New Copenhagen	....	....	....	27·82	·39	....	....	350·00	72·90	·58
		Voided leases	....	....	....	....	....	....	42·86	2,977·29	1,258·44	....
		Sundry claims	....	....	42·50	9·52	·26	4·47	51·52	2,591·96	1,281·97	1·47
Yandicoogina	....	Voided leases	....	....	....	....	....	....	140·76	3,159·20	6,218·83	....
		Sundry claims	....	....	....	....	....	4·32	239·89	574·50	642·82	....
	From District generally :											
	Sundry Parcels treated at :—											
		State Battery, Bamboo Creek	....	....	....	*86·84	4·00	....	....	40·00	*10,312·38	185·04
		State Battery, Marble Bar	....	....	....	....	....	....	....	12·00	*10,582·99	....
		Braeside Sundry Lead Claims	....	....	....	....	2,736·33	....	....	....	....	3,892·95
		Ironclad Battery	....	....	....	....	....	....	....	....	*237·71	....
		Great North Western Gold Co., Ltd., Cyanide Plant	....	....	....	....	....	....	....	....	*271·37	·65
		Various Works	....	....	....	....	....	....	....	237·95	*1,391·56	....
		Reported by Banks and Gold Dealers	77·73	....	....	....	1·16	14,352·61	440·85	....	4·46	4·22
		Totals	**77·73**	....	**7,980·75**	**3,818·28**	**4,303·52**	**15,062·67**	**4,428·90**	**309,379·37**	**307,456·59**	**7,148·26**

NULLAGINE DISTRICT.

Eastern Creek	276L	Rose	....	....	77·00	59·19	1·13	....	....	217·00	204·92	2·99
		Voided leases	....	....	....	....	....	8·96	8·19	5,261·00	9,567·00	11·77
		Sundry claims	....	....	....	....	....	....	12·74	1,409·10	1,600·71	16·90
Elsie	....	Voided leases	....	....	....	....	....	....	....	586·25	1,675·91	....
		Sundry claims	....	....	....	....	....	....	8·28	58·00	188·08	....
McPhee's Creek	....	Voided leases	....	....	....	....	....	....	....	113·00	137·92	....
		Sundry claims	....	....	....	....	....	....	....	134·00	197·09	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
PILBARA GOLDFIELD—continued.												
NULLAGINE DISTRICT.												
Middle Creek	279L	All Nations	....	....	20·00	5·65	....	....	....	940·50	286·01	·15
	229L	Barton	....	....	764·00	655·90	....	1·22	....	4,075·00	2,123·59	1·63
	231L, etc.	Blue Spec Gold Mines, N.L.	....	....	551·00	389·49	....	....	....	26,164·39	14,483·84	....
	300L	Middle Creek	....	....	17·00	5·53	....	....	....	17·00	5·53	....
	267L	Little Wonder	....	....	....	....	....	....	....	3,601·50	932·61	....
		Voided leases	....	....	....	....	....	....	1·02	13,228·65	10,332·19	7·50
		Sundry claims	....	....	238·50	36·31	....	....	....	5,474·10	2,265·08	....
Mosquito Creek	M.L. 51	Hit or Miss	....	....	37·00	10·75	....	....	....	37·00	10·75	....
		Voided leases	....	....	....	....	....	1·07	30·12	8,232·30	12,814·22	....
		Sundry claims	....	....	....	....	....	....	181·64	3,702·44	3,785·88	....
Nullagine	292L	Alice	....	96·19	8·50	17·07	1·49	....	222·71	43·50	102·48	14·35
	297L	Mundella	....	....	17·50	14·54	....	....	....	29·00	103·23	....
	294L	Nullagine View	....	....	....	....	....	....	289·63	41·00	397·35	23·69
	289L	Paul's Leader	....	....	3·00	8·40	....	....	269·40	23·50	333·45	12·60
		Voided leases	....	....	....	....	....	....	40·56	9,002·75	12,498·93	·20
		Sundry claims	....	....	21·00	29·70	....	315·53	668·82	5,930·55	10,272·11	5·24
Twenty Mile Sandy	256L	Bill Jim	....	....	....	....	....	....	....	1,982·50	1,022·55	....
		Voided leases	....	....	....	....	....	....	16·97	5,221·20	7,971·21	·32
		Sundry claims	....	....	....	....	....	33·10	30·50	7,604·85	6,235·21	2·76
	From District generally :—											
	Sundry parcels treated at :											
	Shamrock Battery		....	....	....	....	....	....	....	....	*24·44	1·00
	Twenty Mile Sandy Cyanide Plant		....	....	....	12·56	....	....	....	12·00	*1,738·87	·37
	Various Works		....	....	....	....	....	....	....	112·50	*6,340·55	....
	Reported by Banks and Gold Dealers		168·38	2·61	....	....	....	9,752·26	100·89	....	29·81	5·08
	Totals		**168·38**	**98·80**	**1,754·50**	**1,245·09**	**2·62**	**10,112·14**	**1,881·47**	**103,254·58**	**107,681·52**	**106·55**
Ashburton Goldfield.												
Belvedere	....	Voided leases	....	....	....	....	....	....	9·88	1,560·00	435·86	176·48
Dead Finish	47	Star of the West	....	....	127·00	43·85	·03	....	....	1,417·50	588·57	·03
		Voided leases	....	....	....	....	....	....	....	281·50	279·51	....
		Sundry claims	....	....	25·50	9·77	....	....	11·89	104·25	245·08	....

Melrose	....	Voided leases	....	....	....	....	....	....	....	2,704·00	840·26	213·11
		Sundry claims	....	....	....	....	....	12·41	21·88	562·00	262·78	6·40
Mt. Edith....	....	Sundry claims	....	....	....	....	....	....	....	5·00	3·97	....
Mt. Mortimer	....	Sundry claims	....	....	....	....	....	364·63	315·64	44·50	40·25	74·47
Uaroo	....	Voided leases	....	....	....	....	....	....	....	....	....	7,713·22
		From Goldfield generally :—										
		Sundry claims (Silver – Lead)	....	....	....	....	2,571·59	....	....	....	....	10,823·80
		Reported by Banks and Gold Dealers	....	....	....	....	....	8,884·23	120·11	....	7·12	....
		Totals	....	....	**152·50**	**53·62**	**2,571·62**	**9,261·27**	**479·40**	**6,678·75**	**2,703·40**	**19,007·51**

Gascoyne Goldfield.

Bangemall	....	Voided leases	....	....	....	....	....	....	6·22	350·70	313·82	....
		Sundry claims	....	....	....	....	....	88·97	33·55	36·30	203·47	....
		From Goldfield generally :—										
		Reported by Banks and Gold Dealers	....	....	....	....	....	604·47	1·80	....	....	....
		Totals	....	....	....	....	....	**693·44**	**41·57**	**387·00**	**517·29**	....

Peak Hill Goldfield.

Bulloo Downs	M.L. 63P	Keep it Dark	....	....	....	....	....	....	....	....	....	50·09
Egerton	556P	Pegasus	....	....	215·00	76·53	....	....	193·77	1,869·00	3,667·90	....
	590P	Wyndham	....	....	96·00	7·08	....	....	....	96·00	7·08	....
		Voided leases	....	....	....	....	....	60·86	30·91	5,077·25	2,842·45	....
		Sundry claims	....	....	....	....	....	235·35	23·51	1,501·77	791·34	....
Horseshoe	568P	Horseshoe Lights	....	....	946·25	227·11	....	....	....	3,914·00	894·44	....
	575P	Labourchere Main Lode	....	....	....	....	....	....	....	535·00	60·38	....
	565P	Nathan Bitter	....	....	55·00	32·46	....	....	....	573·00	171·33	....
		Voided leases	....	....	....	....	....	15·57	1,975·37	3,798·38	2,512·94	2·00
		Sundry claims	....	....	....	....	....	20·12	829·58	1,812·05	691·38	....
Jimblebar	....	Voided leases	....	....	....	....	....	....	172·75	7,526·25	2,561·95	·58
		Sundry claims	....	....	....	....	....	13·79	65·95	1,048·05	574·16	....
Mt. Fraser	....	Voided leases	....	....	....	....	....	....	....	389·50	320·96	....
		Sundry claims	....	....	....	....	....	88·28	40·61	400·75	341·14	....
Mt. Seabrook	....	Voided leases	....	....	....	....	....	....	5·05	620·25	428·26	....
		Sundry claims	....	....	10·25	4·32	....	....	....	1,089·35	803·12	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
PEAK HILL GOLDFIELD—continued.												
Peak Hill	512P	Atlantic	....	....	....	....	....	1·69	2·87	4,535·25	578·96	....
	511P	Commercial	....	....	....	....	....	....	....	2,838·75	487·90	....
	584P	Dazzle Star	....	....	35·00	23·35	....	....	....	133·00	57·71	....
	567P	Miner Bird	....	....	112·00	39·75	....	....	....	999·00	519·99	....
	553P	Morning Star	....	....	29·00	29·71	....	....	4·43	2,797·25	403·00	....
	506P	No. 1 North	....	....	....	....	....	....	86·47	6,464·20	1,508·53	....
	492P	North Star	....	....	....	....	....	23·20	69·63	13,147·50	2,064·51	....
	(586P)	Wimpie	....	....	225·00	44·61	....	....	....	225·00	44·61	....
		Voided leases	....	....	....	....	....	7·39	920·21	521,519·33	247,005·56	2,285·63
		Sundry claims	....	....	....	....	....	61·51	306·63	34,064·85	8,924·29	....
Ravelstone	....	Voided leases	....	....	....	....	....	....	101·64	4,219·85	3,117·68	....
		Sundry claims	....	....	....	....	....	....	....	553·60	283·17	....
Wilgeena	572P	O.K.	....	....	....	....	....	....	....	50·00	3·35	....
		Voided leases	....	....	....	....	....	....	23·54	128·50	146·79	....
Wilthorpe	....	Voided leases	....	....	....	....	....	....	....	47·00	20·93	....
		Sundry claims	....	....	....	....	....	....	....	89·00	25·71	....
Yowereena	....	Voided leases	....	....	....	....	....	....	....	19·50	36·46	....
		Sundry claims	....	....	....	....	....	....	....	117·25	203·16	....
		From Goldfield generally :—										
		Sundry Parcels treated at :										
		State Battery, Peak Hill	....	....	....	*79·53	....	....	3·05	15·00	*7,033·66	....
		Australian Machinery and Investment Co.	....	....	....	....	....	....	....	....	*1,677·23	....
		Various Works	....	....	....	....	....	....	....	30·00	*5,661·37	23·12
		Reported by Banks and Gold Dealers	....	....	....	....	....	2,846·65	444·36	....	12·51	....
		Totals	....	....	**1,723·50**	**564·45**	....	**3,374·41**	**5,300·33**	**622,244·43**	**296,485·91**	**2,361·42**

East Murchison Goldfield.

LAWLERS DISTRICT.

Kathleen Valley	1330	Beth-Heno	....	....	75·00	37·28	....	....	....	1,190·83	605·04	....
		Voided leases	....	....	....	....	....	....	144·85	79,222·83	48,388·30	....
		Sundry claims	....	....	....	....	....	14·37	526·03	5,518·75	2,443·79	....

Lawlers	1236, etc.	Australian Gold Production, Ltd.	....	....	465·00	197·90	....	....	....	705·00	309·77	....
		Prior to transfer to present holders	....	....	....	....	....	13·02	....	336,532·18	83,317·15	452·00
		Voided leases	....	....	....	....	....	6·71	692·45	1,285,355·22	491,414·15	14,350·93
		Sundry claims	....	....	40·00	3·88	....	400·21	403·52	17,347·48	9,568·69	268·34
Sir Samuel	1333	Vanguard	....	....	....	....	....	....	....	1,566·00	206·03	....
	(1349)	Westralia	....	....	150·00	44·99	7·28	....	....	150·00	44·99	7·28
		Voided leases	....	....	....	....	....	....	359·03	273,477·55	141,386·56	10,227·52
		Sundry claims	....	....	16·00	15·28	·02	53·89	64·96	7,318·00	4,487·07	·02
	From District generally :—											
	Sundry Parcels treated at :											
	Australian Machinery and Investment Co.		....	....	....	....	....	....	....	5·00	*4,291·25	29·00
	Prior to transfer to present holders		....	....	....	....	....	....	....	....	*1,371·33	15·64
	Australian Machinery and Investment Co. (McP. Cyanide Plant)		....	....	....	2·80	....	2·12	....	12·03	*4,268·05	....
	Great Eastern Mining Syndicate		....	....	....	....	....	....	....	....	*352·19	·12
	Tallon Doon Battery		....	....	....	....	....	....	....	....	*101·50	....
	Vanguard Cyanide Plant		....	....	....	37·89	....	....	....	4·00	*1,008·21	3·18
	State Battery, Sir Samuel (leased)		....	....	....	....	....	....	....	53·50	*2,356·81	....
	Various Works		....	....	....	....	....	....	2·35	1,699·50	*26,067·02	936·09
	Reported by Banks and Gold Dealers		5·51	....	....	....	....	6,406·42	101·91	·05	9·84	....
		Totals	**5·51**	....	**746·00**	**340·02**	**7·30**	**6,896·74**	**2,295·10**	**2,010,157·92**	**821,997·74**	**26,290·12**

WILUNA DISTRICT.

Coles	662J	Black Adder	....	....	....	*167·41	....	....	....	1,689·00	976·91	....
		Voided leases	....	....	....	....	....	....	....	830·50	156·85	....
		Sundry claims	....	....	....	....	....	....	21·03	3,844·50	1,507·23	....
Corboys	680J	Mount Fisher, East	....	....	118·00	254·21	....	....	....	192·00	412·71	....
	435J	Old Toscana	....	....	....	5·08	....	5·24	....	1,037·00	977·72	....
		Voided leases	....	....	....	....	....	....	1·25	13,596·29	9,376·39	5·00
		Sundry claims	....	....	34·00	20·61	....	21·58	....	8,964·35	5,133·82	....
Gum Creek	....	Voided leases	....	....	....	....	....	20·75	....	1,380·00	595·73	....
		Sundry claims	....	....	....	....	....	....	1·36	407·25	13·108	....
Mt. Eureka	....	Voided leases	....	....	....	....	....	....	....	14·225	96·36	....
		Sundry claims –....	....	....	....	....	....	....	....	783·75	548·56	....
Mt. Keith....	....	Voided leases	....	....	....	....	....	....	44·54	20,259·50	13,551·08	....
		Sundry claims	....	....	....	....	....	4·81	227·29	3,862·50	2,480·03	....
New England	....	Voided leases	....	....	....	....	....	5·74	95·70	5,364·25	3,490·87	....
		Sundry claims	....	....	....	....	....	9·31	5·78	4,534·75	3,111·97	....
Wiluna	(674J)	Essex	....	....	40·00	74·37	....	....	....	2,289·00	833·20	....
	682J	Jubilee	....	....	314·75	83·66	....	....	....	314·75	83·66	....
	679J	Lone Hand	....	....	964·25	77·04	....	....	....	1,604·75	127·50	....
	677J	Lucky Hit	....	....	373·25	28·38	....	....	....	781·00	101·38	....
	(631J)	New Brilliant	....	....	25·75	3·73	....	....	....	25·75	3·73	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
EAST MURCHISON GOLDFIELD—continued.												
WILUNA DISTRICT—*continued.*												
Wiluna—*continued*	(631J)	Gipsy Gold Mines	....	....	....	....	....	....	....	135·50	38·63	....
	631J	Brilliant Reduced	....	....	....	....	....	....	....	1,962·75	267·42	....
	194J, etc.	Wiluna Gold Mines, Ltd.	....	....	....	502·76	196·50	....	....	7,345,465·00	1,334,207·23	8,605·91
		Prior to transfer to present holders	....	....	....	....	....	....	....	341,730·57	133,457·92	89·32
		Voided leases	....	....	....	....	....	....	574·76	1,083,677·58	319,282·14	1,349·40
		Sundry Claims	....	....	771·50	155·59	....	105·39	219·08	27,379·40	10,872·09	·33
		From District Generally :—										
		Sundry Parcels treated at :										
		Black Adder Battery	....	....	....	....	....	....	....	....	*154·02	....
		Coolgardie Brilliant Battery	....	....	....	....	....	....	....	....	*235·23	....
		Toscana Cyanide Plant	....	....	....	....	....	....	....	....	*2,577·90	....
		Waratah Cyanide Plant	....	....	....	....	....	....	....	....	*753·10	....
		W. G. Barnfather, L.T.T. 1160H	....	....	139·00	3·99	....	....	....	139·00	3·99	....
		Wiluna East Battery	....	....	....	*124·67	....	....	....	....	*196·17	....
		State Battery, Wiluna	....	....	....	*510·02	....	....	....	637·00	*23,331·95	218·70
		Various Works	....	....	....	....	....	....	....	....	*1,237·68	12·68
		Reported by Banks and Gold Dealers	....	....	....	....	....	49·54	56·58	....	58·49	....
		Totals	....	....	**2,780·50**	**2,011·52**	**196·50**	**222·36**	**1,247·37**	**8,873,029·94**	**1,870,370·74**	**10,281·34**
BLACK RANGE DISTRICT.												
Barrambie	....	Voided leases	....	....	....	....	....	....	22·49	18,443·92	17,355·15	125·60
		Sundry claims	....	....	....	....	....	5·07	170·20	833·55	915·51	....
Bellchambers	....	Voided leases	....	....	....	....	....	....	111·80	4,349·27	3,130·56	....
		Sundry claims	....	....	....	....	....	....	....	1,008·30	547·06	....
Birrigrin	....	Voided leases	....	....	....	....	....	....	820·68	12,042·93	15,086·09	....
		Sundry claims	....	....	....	....	....	....	179·92	2,487·55	1,238·22	....
Currans	....	Voided leases	....	....	....	....	....	18·24	222·89	7,252·25	3,116·68	....
		Sundry claims	....	....	....	....	....	....	29·38	2,158·75	827·18	....
Erroll's	....	Voided leases	....	....	....	....	....	14·17	152·29	14,170·50	9,328·92	....
		Sundry claims	....	....	....	....	....	6·53	399·11	964·75	595·45	....

Hancock's	1074B	Apples	....	....	118·50	350·69	....	....	443·79	975·75	3,156·49	....
	1087B	Apples Extended	....	....	62·00	7·83	....	....	....	62·00	7·83	....
		Voided leases	....	....	....	....	....	....	6,524·37	32,624·50	33,433·33	55·72
		Sundry claims	....	....	....	....	....	4·21	142·89	8,459·10	3,219·53	....
Maninga Marley		Voided leases	....	....	....	....	....	....	195·20	60,833·48	48,494·40	22·55
		Sundry claims	....	....	....	....	....	....	158·16	3,079·65	1,768·16	....
Montague	967B	North End Leases	....	....	595·00	308·75	....	....	....	39,427·95	5,678·23	....
		Voided leases	....	....	....	....	....	....	100·17	39,672·65	16,888·02	....
		Sundry claims	....	....	....	....	....	....	71·09	5,041·35	3,171·19	....
Nunngarra	....	Voided leases	....	....	....	....	....	25·94	952·34	9,509·00	3,655·49	....
		Sundry claims	....	·92	....	....	....	50·27	1,458·98	7,636·40	2,953·69	....
Sandstone	959B	Atlas Gold Mines, Ltd.	....	....	....	....	....	....	....	986·75	180·56	....
		Prior to transfer to present holders	....	....	....	....	....	....	136·06	537·75	686·59	....
	1076B, 1080B....	Black Range Gold Mines, Ltd.	....	....	....	....	....	....	....	84·00	14·34	....
	1075B	Doolette, South	....	....	94·50	26·62	....	....	217·54	2,114·00	2,313·45	....
	958B	Lady Mary	....	....	....	....	....	....	383·35	7,165·75	7,119·35	2·35
		Voided leases	....	....	....	....	....	4·75	4,010·09	692,530·07	444,309·77	11,754·22
		Sundry claims	....	....	100·00	12·77	....	44·95	1,421·07	15,506·95	6,820·85	....
Youanmi	1046B	Camberra	....	....	....	....	....	....	....	1,501·00	447·74	....
		Voided leases	....	....	....	....	....	·36	126·92	729,996·55	273,437·23	10,474·10
		Sundry claims	....	....	....	....	....	1·07	18·79	6,258·55	1,814·66	....
	From District Generally :—											
	Sundry Parcels treated at :											
	State Battery, Sandstone	....	....	....	2·30	....	....	....	290·50	*23,007·38	59·53
	State Battery, Youanmi	....	....	....	....	....	....	....	40·00	*5,461·83	....
	North End Battery Cyanide Plant	....	....	....	....	....	....	....	....	*4,934·14	....
	Various Works	....	....	....	....	....	....	....	92·50	*6,510·12	....
	Reported by Banks and Gold Dealers	....	....	....	....	....	1,459·55	52·23	....	20·38	....
	Totals	....	·92	970·00	708·96	....	1,635·11	18,521·80	1,728,137·97	951,645·57	22,494·07

Murchison Goldfield.

CUE DISTRICT.

Big Bell	2050, etc.	Big Bell Mines, Ltd.	....	....	359,082·00	47,592·14	14,228·82	....	....	3,945,621·00	506,729·58	176,725·54
	2050	(Little Bell)	....	....	....	....	....	....	4·49	579·75	60·95	....
		Voided leases	....	....	....	....	....	....	....	401·00	422·83	....
		Sundry claims	....	....	....	....	....	·39	6·32	376·50	352·57	....
Cuddingwarra	....	Voided leases	....	....	....	....	....	10·59	132·46	102,035·16	56,141·91	100·71
		Sundry claims	....	1·54	100·75	36·71	....	18·46	381·03	9,605·39	5,538·46	9·69
Cue	2247	Victory	....	....	11·00	2·89	....	....	....	226·75	125·38	....
		Voided leases	....	....	....	....	....	202·71	911·60	288,797·44	221,102·80	69·11
		Sundry claims	....	....	345·75	373·98	....	252·92	894·70	44,178·24	20,130·83	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
MURCHISON GOLDFIELD—continued.												
CUE DISTRICT—*continued.*												
Eelya	2241	Eagle Hawk	....	....	394·00	109·51	....	....	....	940·50	254·63	....
		Voided leases	....	....	....	....	....	....	8·78	1,069·00	1,811·26	....
		Sundry claims	....	....	55·00	6·38	....	6·20	143·81	1,811·15	998·86	....
Mindoolah		Voided leases	....	....	....	....	....	3·07	2·54	9,380·28	5,672·31	42·97
		Sundry claims	....	....	....	....	....	....	29·30	3,143·85	2,304·25	....
Reedy	2253	Rand No. 3	....	....	750·00	92·59	....	....	....	4,152·25	1,343·84	....
	1977	Emu	....	....	111·50	30·99	....	....	....	111·50	30·99	....
	2055, etc.	Triton Gold Mines, N.L.	....	....	....	79·69	....	....	....	702,459·25	221,162·66	20,461·06
		Prior transfer to present holders	....	....	....	....	....	....	....	16,338·50	7,471·50	5·00
		Voided leases	....	....	....	....	....	1·46	214·65	6,552·93	10,128·90	1·22
		Sundry claims	....	·62	464·00	88·88	....	170·71	137·16	6,395·50	2,538·33	....
Tuckabianna	2237	Gidgie	....	79·16	24·50	280·33	....	....	79·16	2,671·15	1,803·84	....
	2260	Montorio	....	....	131·25	91·50	....	....	....	131·25	91·50	....
	2244	Winston	....	51·78	....	....	2·30	....	250·24	309·25	100·63	2·30
		Voided leases	....	....	....	....	....	649·70	297·68	12,908·48	7,321·43	....
		Sundry claims	8·21	7·93	28·25	46·92	....	151·38	489·40	4,736·85	2,672·71	....
Tuckanarra		Voided leases	....	....	....	....	....	85·37	3,511·10	19,490·00	22,828·99	172·77
		Sundry claims	....	....	135·75	8·72	....	115·23	789·31	10,040·30	10,263·41	....
Weld Range	2256	Never Can Tell	....	....	267·25	113·03	....	....	....	334·75	154·04	....
		Voided leases	....	....	....	....	....	....	23·64	1,714·75	938·99	....
		Sundry claims	....	....	....	....	....	....	3·90	1,390·25	1,122·89	....
		From District Generally :—										
		Sundry Parcels treated at :										
		State Battery, Cue	....	....	....	*660·62	....	....	....	76·25	*24,094·71	110·22
		State Battery, Tuckanarra	....	....	....	....	....	....	....	518·50	*5,535·57	....
		Various Works	....	....	....	....	....	....	....	7,158·52	*29,387·81	1,147·77
		Reported by Banks and Gold Dealers	16·47	3·98	....	....	·07	3,380·78	107·60	....	22·62	·07
		Totals	**24·68**	**145·01**	**361,901·00**	**49,614·88**	**14,231·19**	**5,048·97**	**8,418·87**	**5,205,655·24**	**1,170,661·98**	**198,847·74**
MEEKATHARRA DISTRICT.												
Abbotts		Voided leases	....	....	....	....	....	....	26·45	36,841·35	38,775·28	....
		Sundry claims	....	....	7·75	20·85	....	....	5·29	3,728·52	2,287·47	....

Burnakura	1849N	New Alliance	....	....	....	....	....	....	....	132·25	114·39	....
		Voided lease	....	....	....	....	....	....	3,247·59	39,040·45	30,775·77	26·90
		Sundry claims	....	....	102·50	36·39	....	17·03	129·24	2,486·55	1,310·84	1·54
Chesterfield	....	Voided leases	....	....	....	....	....	29·02	420·32	6,875·26	7,500·57	·80
		Sundry claims	....	....	....	....	....	....	42·19	960·55	740·97	....
Gabanintha	1854N	Golden Star	....	....	....	....	....	....	....	290·50	268·46	....
	1896N	Mab	....	....	155·75	85·09	....	....	9·32	663·00	596·60	....
	1725N	New Brew	....	....	312·75	302·67	....	....	....	4,643·10	6,121·26	....
		Voided leases	....	....	....	....	....	11·79	28·82	23,911·00	14,064·31	815·57
		Sundry claims	....	....	195·25	85·56	....	16·78	159·05	4,619·00	2,714·01	....
Golden Valley	1927N	Sabbath	....	....	....	....	....	....	....	33·75	17·03	....
		Voided leases	....	....	....	....	....	26·36	74·91	30,238·32	21,847·71	1,102·59
		Sundry claims	....	....	....	....	....	....	18·74	2,905·44	1,695·15	....
Gum Creek	....	Voided leases	....	....	....	....	....	25·27	91·96	3,893·08	3,819·91	....
		Sundry claims	....	....	....	....	....	4·37	84·86	727·25	636·85	....
Holden's	1551N	New Waterloo	....	....	....	....	....	....	·99	1,468·00	918·92	....
		Voided leases	....	....	....	....	....	....	18·00	16,593·00	6,401·50	....
		Sundry claims	....	....	....	....	....	164·95	49·07	425·15	279·25	....
Jillawarra	1871N	Werribie	....	....	....	....	....	....	128·85	451·25	749·62	....
		Voided leases	....	....	....	....	....	....	1,134·68	1,548·55	2,815·78	....
		Sundry claims	....	....	....	....	....	173·02	150·04	440·75	403·14	....
Meeka Pools	....	Voided leases	....	....	....	....	....	....	....	111·58	82·27	....
		Sundry claims	....	....	....	....	....	....	2·84	233·57	205·38	....
Meekatharra	1861N	Adele May	....	....	19·50	18·26	....	....	....	43·50	46·26	....
	1922N	Albury Heath	....	....	65·50	176·47	....	....	....	439·00	850·40	....
	1855N	Commodore	....	....	83·25	9·31	....	....	....	1,160·25	380·89	....
	1553N	Consols North	....	....	....	....	....	....	....	659·75	1,359·33	....
	1571N	Coolgardie Brilliant, N.L.	....	....	59·25	4·82	....	....	....	2,451·36	541·38	....
	1571N	(Pharlap)	....	....	....	....	....	....	....	8,107·50	4,907·48	....
	1894N	Fenian Leases	....	....	....	....	....	....	....	329,424·69	261,787·67	....
	477N	(Fenian)	....	....	....	....	....	....	....	8,831·75	18,289·22	....
	1893N	Halcyon	....	....	1,858·85	222·50	....	....	·78	6,206·35	855·23	....
	1888N	Haveluck	....	....	818·00	139·29	....	....	56·94	3,025·75	872·08	....
	1559N	Ingliston	....	....	36·05	24·64	....	....	498·32	1,846·00	1,665·02	....
	1542N	Ingliston Alberts	....	....	....	....	....	....	....	305·50	446·00	....
	1542N	(Ingliston Alberts Leases)	....	....	....	....	....	....	....	2,983·70	1,283·06	....
	1595N, etc.	Ingliston Consols Extended Leases	....	....	....	....	....	....	....	873,719·47	357,046·42	....
		Prior to transfer to present holders	....	....	....	....	....	....	....	1,536·25	4,248·25	·30
	1920N	Ingliston South	....	....	....	....	....	....	....	355·50	368·17	....
	1547N	Lady Central	....	....	63·25	25·73	....	....	19·36	96·00	51·78	....
	1547N	Meekatharra Central Gold, N.L.	....	....	....	....	....	....	5·29	4,842·25	2,463·30	....
	1547N	Lady Central Leases	....	....	....	....	....	....	11·06	2,951·42	5,198·33	....
	1899N	Marmont	....	....	....	....	....	....	89·33	60,425·20	43,192·98	....
	1906N	Marmont Extended	....	....	....	....	....	....	....	1,748·95	1,813·96	....
	580N	Marmont Extended Leases	....	....	....	....	....	....	....	152·00	129·61	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950. Alluvial. Fine ozs.	Dollied and Specimens. Fine ozs.	Ore treated. Tons (2,240 lb.).	Gold therefrom. Fine ozs.	Silver. Fine ozs.	Total Production. Alluvial. Fine ozs.	Dollied and Specimens. Fine ozs.	Ore treated. Tons (2,240 lb.).	Gold therefrom. Fine ozs.	Silver. Fine ozs.
MURCHISON GOLDFIELD—continued.												
MEEKATHARRA DISTRICT—*continued.*												
	1577N	Mopoke	....	....	....	....	....	....	12·47	1,338·25	820·16	....
	1923N	Peter Pan	....	....	74·75	4·00	....	....	....	283·75	22·87	....
	1529N	Prohibition	....	....	....	*59·52	....	....	....	3,950·00	*1,853·54	·04
	1529N, etc.	Prohibition Gold Mining Co., N.L.	....	....	....	....	....	....	....	24,844·25	4,978·31	11·83
	1529N	Prior to transfer to present holders	....	....	....	....	....	....	....	29,422·00	4,971·30	....
	1934N	United	....	....	....	....	....	....	....	50·50	22·28	....
		Voided leases	....	....	....	....	....	3·88	1,337·17	395,312·73	218,621·43	2,454·74
		Sundry claims	....	....	469·25	106·86	....	229·71	628·85	24,716·95	9,680·25	....
Mistletoe	....	Voided leases	....	....	....	....	....	4·15	1,000·24	417·00	486·21	....
		Sundry claims	....	....	....	....	....	119·14	71·85	19·75	2·03	....
Mt. Maitland	....	Voided leases	....	....	....	....	....	....	....	88·00	80·11	....
		Sundry claims	....	....	....	....	....	....	....	420·75	240·86	....
Munara Gully	....	Voided leases	....	....	....	....	....	....	....	13,283·50	6,559·93	....
		Sundry claims	....	....	....	....	....	....	34·23	1,009·75	373·74	....
Nannine	1872N	Blue Pedro	....	15·26	995·00	57·17	....	....	15·26	9,566·40	2,018·18	....
		Voided leases	....	....	....	....	....	37·25	828·76	116,080·98	73,399·21	167·45
		Sundry claims	....	....	....	....	....	120·08	1,248·76	6,109·43	4,658·63	....
Quinns	....	Voided leases	....	....	....	....	....	7·30	1,186·50	33,356·91	13,464·37	90·70
		Sundry claims	....	....	....	....	....	15·07	1,289·65	3,841·67	2,718·33	....
Ruby Well	....	Voided leases	....	....	....	....	....	....	43·46	7,461·00	4,046·70	....
		Sundry claims	....	....	....	....	....	1,015·87	409·39	520·25	629·60	....
Stake Well	....	Voided leases	....	....	....	....	....	....	200·12	21,362·00	9,566·18	....
		Sundry claims	....	....	....	....	....	31·91	34·73	1,003·60	584·54	....
Star of the East	....	Voided leases	....	....	....	....	....	....	....	27,244·00	20,305·40	....
		Sundry claims	....	....	....	....	....	....	....	127·62	94·97	....
Yaloginda	1853N	Bluebird	....	....	945·00	254·82	....	....	....	5,912·00	1,694·30	....
		Voided leases	....	....	....	....	....	19·03	1,972·23	28,175·54	14,609·36	8·68
		Sundry claims	....	....	173·25	16·64	....	61·89	647·51	10,606·42	4,899·37	....
	From District generally :— Sundry Parcels treated at : T.A. Davis, L.T.T. 1143H		....	....	....	·99	....	....	....	....	·99	....

		State Battery, Meekatharra	....	....	....	*889·83	....	....	....	99·50	*25,838·30	19·00
		Meekatharra Sands Treatment and Mining, N.L.	....	....	....	*2,344·87	....	....	....	....	*6,227·43	....
		Various Works	....	....	....	....	....	....	....	172·75	*6,729·60	342·17
		Reported by Banks and Gold Dealers	....	....	....	....	....	12,159·05	179·70	13·50	40·66	....
		Totals	....	**15·26**	**6,434·90**	**4,886·28**	....	**14,292·92**	**17,645·17**	**2,261,384·21**	**1,293,178·40**	**5,042·31**

DAY DAWN DISTRICT.

Day Dawn	(678D)	Creme D'or	....	....	....	5·44	....	....	....	131·75	33·47	....
	573D, etc.	Mountain View Gold, N.L.	....	....	1,654·50	2,331·78	79·75	....	....	6,687·10	14,136·52	99·71
		Prior to transfer to present holders	....	....	....	....	....	....	94·05	10,060·78	32,623·97	....
	576D	New Fingall....	....	....	....	....	....	6·12	6·84	3,230·00	1,226·01	....
		Voided leases	....	....	....	....	....	160·64	826·65	1,921,956·61	1,225,566·28	169,210·44
		Sundry claims	....	12·20	89·00	65·29	·41	96·42	521·05	13,150·51	6,555·32	·41
Lake Austin	....	Voided leases	....	....	....	....	....	613·00	3,079·62	36,872·20	51,050·49	....
		Sundry claims	....	....	9·25	5·28	....	59·07	965·49	3,224·94	1,268·12	....
Mainland	....	Voided leases	....	....	....	....	....	·41	3,296·77	7,575·62	25,026·07	....
		Sundry claims	....	....	....	....	....	17·85	771·56	1,337·95	701·31	....
Pinnacles	676D	Eclipse Amalgamated North	....	....	159·00	13·75	....	....	....	159·00	13·75	....
	670D	Eclipse North	....	....	115·50	10·69	....	....	....	141·25	11·18	....
	679D	Table Mine	....	....	152·75	41·63	....	....	....	163·00	46·42	....
Voided leases	....	Voided leases	....	....	....	....	....	4·90	1,213·68	18,117·00	9,869·29	....
		Sundry claims	....	....	27·75	16·55	....	62·93	509·50	4,344·67	1,753·04	....
		From District generally :—										
		Sundry Parcels treated at :										
		Various Works	....	....	....	....	....	....	16·61	988·00	1,988·33	....
		Reported by Banks and Gold Dealers	16·18	....	....	....	·01	2,179·22	37·30	....	12·57	·01
		Totals	**16·18**	**12·20**	**2,207·75**	**2,490·41**	**80·17**	**3,200·56**	**11,339·12**	**2,081,140·38**	**1,371,882·14**	**169,310·57**

MOUNT MAGNET DISTRICT.

Jumbulyer	1410M	Gold Bug	....	....	147·00	6·33	....	....	2·20	623·20	204·49	....
		Voided leases	....	....	....	....	....	....	13·37	680·10	361·74	....
		Sundry claims	....	....	7·25	8·76	....	20·32	116·27	1,205·70	878·98	....
Lennonville	1308M	Empress	....	....	....	....	....	....	....	460·00	167·30	....
	1379M	Galtee Moore	....	....	....	....	....	....	....	6,026·00	1,583·06	·80
		Voided leases	....	....	....	....	....	....	3,226·91	145,016·55	126,817·92	458·82
		Sundry claims	....	....	....	....	....	23·30	108·82	13,979·32	5,438·99	....
Mt. Magnet	1449M	Blue Doe	....	....	83·75	52·95	....	....	....	83·75	52·95	....
	1255M, etc.	Edward Carson Leases	....	....	....	36·06	·76	....	....	17,890·50	12,819·89	7·76
	1286M	Evening Star	....	....	122·75	8·02	....	....	36·37	3,279·92	1,236·83	....
	1287M	Havelock	....	....	....	....	....	....	11·05	4,332·50	840·14	....
	1282M, etc.	Hill 50 Gold Mine, N.L.	....	....	44,632·00	11,516·66	268·91	....	....	513,185·90	146,071·93	1,720·31

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
MURCHISON GOLDFIELD—continued.												
MOUNT MARGARET DISTRICT—*continued.*												
Mt. Magnet—*continued*	1246M	(Neptune)	....	....	....	....	....	....	829·41	8,787·65	4,122·61	·21
	1361M	Jupiter	....	....	....	....	....	....	8·3	571·30	236·47	....
	1444M	Late Comer	....	2·53	32·75	36·49	....	....	2·53	291·25	186·18	....
	1447M	Morning Star	....	....	119·00	27·58	....	....	....	229·90	60·02	....
	1441M	Perseverance	....	....	....	....	....	....	....	475·75	52·32	....
	1322M	Three Boys	....	....	32·00	7·81	....	....	231·11	532·78	676·10	....
		Voided leases	....	....	....	....	....	29·26	9,544·06	829,640·36	310,714·55	851·39
		Sundry claims	....	....	343·50	105·36	....	122·27	2,626·24	59,632·40	29,425·43	4·49
Mt. Magnet, East	....	Voided leases	....	....	....	....	....	63·29	764·53	5,522·28	2,811·75	....
		Sundry claims	....	....	....	....	....	....	37·22	418·25	428·29	....
Moyagee	1355M	Moyagee	....	....	....	....	....	....	....	2,621·25	*5,106·19	375·25
	1355M, etc.	Moyagee Leases	....	....	....	....	....	....	....	4,641·00	5,489·13	382·52
		Voided leases	....	....	....	....	....	....	23·59	5,132·35	7,617·85	....
		Sundry claims	....	....	....	....	....	14·44	176·21	1,516·25	1,746·42	....
Paynesville	....	Voided leases	....	....	....	....	....	....	1,613·34	449·77	1,116·15	....
		Sundry claims	....	....	....	....	....	3·36	540·21	882·51	1,372·00	....
Winjangoo	....	Voided leases	....	....	....	....	....	·99	191·88	72·00	69·98	....
		Sundry claims	....	....	....	....	....	....	223·32	237·53	71·58	....
		From District generally :—										
		Sundry Parcels treated at :—										
		State Battery, Boogardie	....	....	....	....	....	....	....	125·26	*33,652·05	4·20
		Palmer & Dewar, L.T.T. 1124H	....	....	....	....	....	....	....	....	*288·47	....
		B. Caratti (L.T.T. 1048H)	....	....	....	....	....	....	....	3·00	*30·38	....
		Empress Battery	....	....	....	....	....	....	....	....	*36·98	....
		Heine's Tailings Treatment Plant (L.T.T. 1080H)	....	....	....	....	....	....	....	....	*165·96	3·78
		Heine's Tailings Treatment Plant (L.T.T. 1046H)	....	....	....	....	....	....	....	....	*48·68	5·26
		Welcome Cyanide Plant	....	....	....	....	....	....	....	10·00	*941·39	....
		Various Works	....	....	....	....	....	....	....	43·06	*17,428·06	1·00
		Reported by Banks and Gold Dealers	19·10	25·85	....	....	....	2,280·26	114·28	8·00	64·95	·22
		Totals	**19·10**	**28·38**	**45,520·00**	**11,806·02**	**269·67**	**2,557·49**	**20,433·75**	**1,628,607·40**	**720,434·16**	**3,816·01**
Yalgoo Goldfield.												
Bilberatha	....	Voided leases	....	....	....	....	....	1·27	90·94	3,384·50	1,845·05	....
		Sundry claims	....	....	....	....	....	....	6·64	3,075·05	1,401·56	....

Carlaminda	....	Voided leases	....	....	....	....	....	1·28	3·39	2,056·57	862·42	3·30
		Sundry claims	....	....	....	....	....	....	....	1,368·50	600·68	....
Field's Find	907	Brown's Reward	....	....	....	....	....	....	....	300·00	75·91	....
	907, etc.	Brown's Reward Leases	....	....	....	....	....	....	....	4,540·55	3,800·16	....
	1113	Field's Find	....	....	44·00	17·96	·10	....	....	44·00	17·96	·10
	1220	Field's Find Central	....	....	5·00	3·53	....	....	....	5·00	3·53	....
	1119	Field's Find Central West	....	....	9·50	4·38	....	....	....	130·50	34·03	·8
	1119, etc.	Field's Find Central West Leases	....	....	....	....	....	....	....	4,625·00	1,074·53	56·69
	1207	Rose Marie	....	....	193·00	47·56	....	....	....	394·67	200·94	....
		Voided leases	....	....	....	....	....	....	226·72	40,635·41	28,671·03	....
		Sundry claims	....	....	10·00	2·83	....	5·77	188·67	5,455·75	1,769·62	....
Goodingnow	1063	Ark	....	....	145·00	139·26	....	....	1·23	1,731·00	851·11	....
	1102	Astor	....	....	26·00	14·39	....	....	....	5,965·25	3,188·54	....
	1198	Astor South	....	....	....	....	....	....	....	498·50	114·17	....
	1025	Carnation	....	....	221·00	217·30	....	....	....	18,237·55	13,576·63	....
	1206	Orchid	....	....	....	....	....	....	....	157·50	33·74	....
	1145	Oversight	....	....	....	....	....	....	....	2,053·35	709·40	....
	1208	Oversight South	....	....	361·00	205·63	....	....	8·03	1,898·00	801·46	....
		Voided leases	....	....	....	....	....	146·70	280·63	50,161·06	46,775·43	....
		Sundry claims	....	....	61·00	4·41	....	152·96	169·70	10,193·25	5,090·58	....
Gullewa	1189	King Solomons Mine	....	....	....	....	....	....	....	315·00	135·89	5·79
	1189, etc.	(King Solomons Mines, Ltd.)	....	....	....	....	....	....	....	5,130·10	2,101·25	26·49
		Voided leases	....	....	....	....	....	....	19·05	34,468·50	18,729·37	81·42
		Sundry claims	....	....	....	....	....	....	170·45	4,391·25	1,918·24	....
Kirkalucka	....	Voided leases	....	....	....	....	....	....	....	61·25	45·10	....
		Sundry claims	....	....	....	....	....	....	17·79	257·30	126·29	....
Messenger's Patch	(1197)	Gnow's Nest	....	....	....	1·61	....	8·64	....	115·00	250·03	....
		Voided leases	....	....	....	....	....	....	349·71	39,721·51	28,314·92	1,083·01
		Sundry claims	....	....	....	....	....	463·12	333·98	1,595·10	588·36	·07
Mt. Farmer	....	Voided leases	....	....	....	....	....	....	....	64·00	40·19	....
		Sundry claims	....	....	....	....	....	....	....	462·90	145·06	....
Mt. Gibson	....	Voided leases	....	....	....	....	....	....	6·44	526·50	888·70	....
		Sundry claims	....	....	37·00	5·89	....	1·03	44·72	1,123·35	494·25	1·00
Ninghan	....	Voided leases	....	....	....	....	....	....	....	10·00	1·41	....
		Sundry claims	....	....	....	....	....	....	....	324·75	123·28	....
Noongal	1201	Hard To Find	....	....	....	....	....	....	....	114·00	111·83	....
	1203	Revival	....	....	....	....	....	....	....	80·00	132·93	4·04
		Voided leases	....	....	....	....	....	7·88	31·96	11,069·75	5,526·90	....
		Sundry claims	....	....	....	....	....	39·32	310·31	8,499·05	3,561·25	....
Nyounda	....	Voided leases	....	....	....	....	....	....	217·63	416·00	183·91	....
		Sundry claims	....	....	....	....	....	....	30·88	722·00	180·83	....
Pinyalling	1217	Broken Doll	....	....	2·00	63·64	....	....	200·30	5·55	133·20	....
		Voided leases	....	....	....	....	....	....	93·80	2,296·35	959·50	....
		Sundry claims	....	....	....	....	....	3·13	134·09	1,463·00	844·00	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
YALGOO GOLDFIELD—*continued.*												
Retaliation	....	Voided leases	....	....	....	....	....	....	....	5,089·25	1,872·98	....
		Sundry claims	....	....	....	....	....	....	....	778·25	304·71	....
Rothsay	1216	Dollar	....	....	....	2·14	....	....	....	....	2·14	....
		Voided leases	....	....	....	....	....	....	24·06	40,680·75	10,775·84	....
		Sundry claims	....	....	....	....	....	....	·73	6,469·50	2,562·03	....
Wadgingarra	....	Voided leases	....	....	....	....	....	....	....	691·11	650·63	....
		Sundry claims	....	....	....	....	....	....	....	2,131·30	559·83	....
Warda. Warra	....	Voided leases	....	....	....	....	....	....	....	10,760·50	5,862·04	....
		Sundry claims	....	....	....	....	....	....	....	933·75	369·87	....
Warriedar	....	Voided leases	....	....	....	....	....	....	....	13,661·50	4,607·88	7·30
		Sundry claims	....	....	....	....	....	....	2·84	8,782·85	1,892·46	....
Yalgoo	....	Voided leases	....	....	....	....	....	....	3·23	6,314·50	9,965·18	....
		Sundry claims	....	....	....	....	....	....	23·56	2,622·75	1,010·02	....
Yuin	....	Voided leases	....	....	....	....	....	....	127·12	68,139·50	27,908·57	130·13
		Sundry claims	....	....	....	....	....	....	4·70	335·50	67·53	....
		From District generally :—										
		Sundry Parcels treated at :—										
		State Battery, Payne's Find	....	....	....	....	....	....	....	38·50	*4,529·92	....
		State Battery, Warriedar	....	....	....	....	....	....	....	....	*6,503·21	....
		State Battery, Yalgoo	....	....	....	....	....	....	....	....	*1,193·63	....
		P. W. Nevill's Cyanide Plant	....	....	....	....	....	....	....	....	*291·65	72·23
		Various Works	....	....	....	....	....	9·42	....	664·00	*3,033·35	27·61
		Reported by Banks and Gold Dealers	2·71	....	....	....	....	944·69	58·32	....	34·44	·20
		Totals	**2·71**	....	**1,114·50**	**730·53**	**·10**	**1,785·21**	**3,181·62**	**438,236·68**	**261,033·08**	**1,500·18**
Mt. Margaret Goldfield.												
MOUNT MORGANS DISTRICT.												
Australia United....	....	Voided leases	....	....	....	....	....	....	1,911·63	15,913·69	23,305·76	1·76
		Sundry claims	....	....	....	....	....	....	580·98	1,307·50	2,227·65	....

Eucalyptus	....	Voided leases	....	....	....	....	....	....	2,878·56	1,603·85	3,251·01	....
		Sundry claims	....	3·34	....	....	....	....	591·62	2,145·30	1,990·31	....
Linden	522F	Ailsa	....	....	22·00	26·22	....	....	....	1,047·00	551·57	....
	539F	Democrat	....	....	110·75	188·08	....	....	1·19	4,729·00	7,900·12	....
	554F	Devon	....	....	....	....	....	....	....	11·50	13·39	....
	553F	Local Lady	....	....	791·25	383·62	....	....	....	2,810·75	2,812·64	....
	521F	North Democrat	....	....	167·50	347·32	....	....	....	3,122·25	6,110·22	....
	529F	Second Fortune	....	....	....	....	....	....	....	517·00	282·05	....
		Voided leases	....	....	....	....	....	7·53	565·78	60,096·31	48,051·10	·68
		Sundry claims	....	....	68·00	32·80	....	132·11	244·96	19,097·85	13,712·77	....
Mt. Margaret	M.A. 12F	The United Aborigines Mission	....	....	....	....	....	113·08	18·87	403	133·14	·09
		Voided leases	....	....	....	....	....	12·13	1·89	8,900·39	5,291·51	12·55
		Sundry claims	....	....	8·25	1·63	....	25·22	111·18	1,779·60	658·99	....
Mt. Morgans	399F, etc.	Morgans Gold Mines, Ltd.	....	....	37·50	8·20	....	....	....	4,504·30	*13,784·24	....
		Prior to transfer to present holders	....	....	....	....	....	....	16·66	779,578·43	354,225·86	5,552·63
		Voided leases	....	....	....	....	....	17·95	148·79	61,354·50	34,786·53	77·86
		Sundry claims	....	....	53·00	10·72	....	36·41	398·78	5,012·57	3,322·61	....
Murrin Murrin	....	Voided leases	....	....	....	....	....	10·43	231·35	136,940·22	104,029·97	29·60
		Sundry claims	....	....	....	....	....	51·15	557·24	6,425·33	4,433·63	....
Redcastle	557F	Trixie	....	....	50·00	3·96	....	....	....	146·00	31·54	....
		Voided leases	....	....	....	....	....	4·49	436·54	4,107·20	4,043·41	....
		Sundry claims	....	....	....	....	....	....	113·84	1,133·57	636·03	....
Yundamindera	510F	Landed at Last	....	....	....	....	....	....	....	4,332·00	683·02	....
		Voided leases	....	....	....	....	....	....	110·93	74,153·85	49,211·33	5·82
		Sundry claims	....	....	130·00	31·99	....	3·01	271·93	6,624·35	4,770·93	....
		From District generally :—										
		Sundry Parcels treated at :—										
		C. C. Crocker Anniversary Battery	....	....	....	....	....	....	....	10·00	18·70	....
		Hill End Cyanide Plant	....	....	....	....	....	....	....	....	*556·95	....
		Rymer's Cyanide Plant	....	....	....	....	....	....	....	....	*1,162·22	....
		D. Turbett Cyanide Plant	....	....	....	....	....	....	....	....	*1,232·20	....
		State Battery, Linden	....	....	....	486·65	....	....	9·16	293·29	*15,341·90	....
		Various Works	....	....	....	....	....	....	....	1,257·81	*5,587·82	99·97
		Reported by Banks and Gold Dealers	18·97	....	....	....	....	2,990·48	141·84	10·30	95·75	·68
		Totals	**18·97**	**3·34**	**1,438·25**	**1,521·19**	....	**3,403·99**	**9,343·72**	**1,209,368·71**	**714,246·87**	**5,781·64**

MOUNT MALCOLM DISTRICT.

Cardinia	1795C	Rangoon	....	....	....	*30·62	....	....	6·49	250·00	149·22	....
	1833C	Triangle	....	....	6·50	21·37	....	....	....	6·50	21·37	....
	1805C	Wanghi	....	....	....	....	....	....	....	280·00	18·28	....
		Voided leases	....	....	....	....	....	13·87	1,591·66	4,875·24	4,006·52	....
		Sundry claims	....	....	....	....	....	4·25	121·91	1,865·25	575·01	·66

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.
MOUNT MARGARET GOLDFIELD—continued.												
MOUNT MALCOLM DISTRICT—*continued.*												
Diorite	1786c	Puzzle	....	....	143·00	120·09	....	....	....	2,706·00	2,761·96	....
		Voided leases	....	....	....	....	....	....	945·65	36,103·03	32,335·98	33·18
		Sundry claims	....	2·81	3·00	4·75	....	11·21	332·13	4,626·80	4,432·31	....
Dodger's Well	....	Voided leases	....	....	....	....	....	....	57·90	1,373·30	1,936·52	....
		Sundry claims	....	....	....	....	....	·95	28·32	1,440·25	904·23	....
Lake Darlot	1814c	British King	....	....	....	....	....	....	....	25·00	3·24	·33
	1820c	The Dragon	....	....	....	....	....	....	....	767·00	474·41	....
		Voided leases	....	....	....	....	....	....	4,482·18	69,935·46	51,468·37	7·23
		Sundry claims	....	....	....	....	....	67·68	557·70	7,923·34	5,265·70	2·60
Leonora	1829c	Jessie Alma	....	....	113·00	170·71	....	....	454·52	542·50	1,788·34	....
	1594c	Leonora Central G.M. Co., N.L.	....	....	....	....	....	....	....	8,621·00	853·23	....
	1788c	Little Gwalia	....	....	60·00	28·77	....	....	....	800·00	86·60	....
	1341c, etc.	Sons of Gwalia, Ltd.	....	....	88,745·00	25,557·66	2,027·20	....	....	5,484,270·53	2,216,655·53	156,858·24
		Prior to transfer to present holders	....	....	....	....	....	....	....	109,081·00	55,989·21	8·66
		Voided leases	....	....	....	....	....	....	1,866·86	166,178·00	89,768·33	94·57
		Sundry claims	....	3·30	210·00	44·82	....	37·73	358·00	18,217·25	11,602·61	....
Malcolm	....	Voided leases	....	....	....	....	....	11·65	47·07	62,656·53	47,563·43	....
		Sundry claims	....	....	....	....	....	5·75	33·39	4,371·47	2,670·09	·12
Mertondale	....	Voided leases	....	....	....	....	....	....	....	89,024·75	60,935·32	1,497·58
		Sundry claims	....	....	....	....	....	1·82	85·74	3,216·41	2,295·52	....
Mt. Clifford	....	Voided leases	....	....	....	....	....	....	1,623·35	9,556·96	16,492·17	....
		Sundry claims	....	....	35·00	3·72	....	53·98	351·65	5,569·70	3,485·47	....
Pig Well	....	Voided leases	....	....	....	....	....	....	....	13,587·32	14,676·58	63·68
		Sundry claims	....	....	....	....	....	....	34·61	2,896·65	1,225·46	....
Randwick	1794c	Mighty Splash	....	....	12·00	3·78	....	....	7·27	771·00	82·79	....
		Voided leases	....	....	....	....	....	....	239·49	10,141·65	9,653·78	....
		Sundry claims	....	....	....	....	....	66·57	164·02	2,488·64	1,307·45	....
Webster's Find	....	Voided leases	....	....	....	....	....	30·30	....	22,167·50	14,377·65	....
		Sundry claims	....	....	....	....	....	36·84	695·68	2,356·15	1,530·56	....
Wilson's Creek	....	Voided leases	....	....	....	....	....	....	....	333·50	168·27	....
		Sundry claims	....	....	....	....	....	·70	4·24	316·00	261·12	....

Wilson's Patch	....	Voided leases	....	....	....	....	....	....	99·38	28,863·35	13,050·19	1·05
		Sundry claims	....	....	....	....	....	4·68	50·57	1,572·16	1,389·46	....
	From District generally :—											
	Sundry Parcels treated at :—											
		State Battery, Darlot	....	....	....	*25·93	....	....	....	10·00	*785·47	....
		Reefer Cyanide Plant	....	....	....	*203·50	....	....	....	20·00	*3,122·05	22·38
		Various Works	....	....	....	....	....	....	....	789·50	*22,175·93	135·97
		Reported by Banks and Gold Dealers	5·14	....	....	....	....	3,458·12	249·87	21·50	51·57	....
		Totals	**5·14**	**6·11**	**89,327·50**	**26,215·72**	**2,027·20**	**3,806·10**	**14,489·65**	**6,180,618·19**	**2,698,397·30**	**158,726·25**

MOUNT MARGARET DISTRICT.

Burtville	2446T	Boomerang	....	....	195·75	917·27	100·00	....	....	1,307·75	7,436·97	399·03
	2476T	Happy Find	....	....	82·25	295·46	55·00	2·60	....	937·75	3,475·22	204·83
	2138T	Nil Desperandum	....	....	24·75	82·62	....	....	5·30	1,604·12	3,431·22	....
		Voided leases	....	....	....	....	....	2·29	413·80	69,287·83	104,974·53	275·27
		Sundry claims	....	....	32·00	25·09	....	2·65	208·27	7,310·91	5,441·91	....
Duketon	....	Voided leases	....	....	....	....	....	5·35	3,216·10	31,889·42	22,542·63	....
		Sundry claims	....	....	....	....	....	....	528·26	2,402·65	2,164·55	29·76
Eagle's Nest	....	Voided leases	....	....	....	....	....	....	145·34	534·50	1,238·22	....
		Sundry claims	....	....	....	....	....	24·07	487·05	1,046·35	360·11	....
Erlistoun	2508T	Morgood	....	....	110·00	62·69	....	....	....	110·00	62·69	....
	(2345T)	Morgood	....	....	....	....	....	....	....	532·50	508·96	....
		Prior to transfer to present holders	....	....	....	....	....	....	....	106,057	75,902·56	4,316·81
	2500T	Westralia	....	....	....	....	....	....	....	....	1·56	....
		Voided leases	....	....	....	....	....	10·07	393·41	49,966·15	24,897·96	11·00
		Sundry claims	....	....	46·25	21·35	....	1,181·65	148·23	5,510·84	3,737·11	....
Euro	....	Voided leases	....	....	....	....	....	....	65·14	91,821·50	37,678·25	....
		Sundry claims	....	....	....	....	....	4·87	73·04	1,313·50	797·32	....
Laverton	2216T	Beria Main Lode	....	....	....	....	....	....	4·74	6,640·35	1,553·38	....
	2245T, etc.	Lancefield Leases	....	....	5,761·25	395·85	....	....	....	19,633·00	3,191·93	....
	2245T	(Lancefield Extended West)	....	....	....	....	....	....	....	881·25	846·77	....
	2489T	(Wedge)	....	....	....	....	....	....	....	222·00	21·19	....
	2478T	Lancefield North	....	....	....	....	....	....	....	1,923·00	388·41	....
	2499T	Pinnacles	....	....	25·00	2·20	....	....	....	54·00	7·41	....
	2507T	Roka	....	....	176·25	18·97	....	....	....	291·00	36·47	....
	T.L. 2T, 5T, etc.	United Gold Recoveries Pty., Ltd.	....	....	....	*871·73	1,115·41	....	....	....	*2,178·01	1,951·05
		Voided leases	....	....	....	....	....	28·59	2,024·11	2,068,422·27	811,609·61	56,923·16
		Sundry claims	....	....	144·00	52·56	....	215·58	1,475·35	17,178·25	9,095·26	....
Mt. Barnicoat	2509T	Ida H. North	....	....	9·00	16·89	....	....	....	9·00	16·89	....
	2512T	White Horse	....	....	220·50	462·70	....	....	....	220·50	462·70	....
		Voided leases	....	....	....	....	....	....	23·08	1,904·00	1,001·31	....
		Sundry claims	....	....	27·50	4·78	....	....	·68	1,267·75	1,082·92	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
MOUNT MARGARET GOLDFIELD—continued.												
MOUNT MARGARET DISTRICT—*continued.*												
Mt. Shenton	....	Voided leases	....	....	....	....	....	....	....	15·00	26·65	....
		Sundry claims	....	....	....	....	....	....	....	279·25	209·67	....
		From District generally :—										
		Sundry Parcels treated at :—										
		State Battery, Laverton	....	....	....	*1,666·59	....	....	....	97·50	*11,662·90	15·64
		D. Cable, L.T.T. 978H	....	....	....	....	....	....	....	....	*1,335·70	....
		J. Shepherd, M.A. 23T	....	....	....	....	....	....	....	....	*99·55	....
		Various Works	....	....	....	....	....	....	....	159·50	*17,961·14	·24
		Reported by Banks and Gold Dealers	7·99	....	....	....	....	2,516·21	108·08	....	26·76	....
		Totals	**7·99**	....	**6,854·50**	**4,896·75**	**1,270·41**	**3,993·93**	**9,319·98**	**2,490,830·39**	**1,157,466·40**	**64,126·79**
North Coolgardie Goldfield.												
MENZIES DISTRICT.												
Conet Vale	5732z	Central Coonega	....	....	....	....	....	....	....	83·00	20·16	....
	5756z	Sand Duke	....	....	....	4·10	·31	....	....	....	4·10	·31
	5754z	Sand Queen	....	....	412·50	66·91	·70	....	....	412·50	66·91	·70
		Voided leases	....	....	....	....	....	....	419·74	266,639·72	193,083·79	5,351·38
		Sundry claims	....	....	....	....	....	....	40·19	1,895·91	995·96	....
Goongarrie	5740z	Gull's Blow	....	....	47·50	11·44	....	....	....	257·25	116·90	....
	5735z	Pretty Easy	....	....	10·00	25·59	....	....	1·22	10·00	25·59	....
		Voided leases	....	....	....	....	....	·94	1,384·04	29,828·79	18,060·05	....
		Sundry claims	....	....	43·00	23·10	....	46·46	2,054·17	2,668·27	3,086·22	....
Menzies	5543z	Black Swan	....	....	....	....	....	....	....	1,000·63	1,633·52	9·08
	5736z	Bodington	....	....	28·00	1·84	....	....	2·82	73·00	52·97	....
	5694z	Dark Horse	....	....	....	....	....	....	....	83·00	293·76	....
	5511z	First Hit	....	....	157·00	113·19	1·91	....	....	1,955·75	4,926·25	1·91
	5511z, etc.	(First Hit G.M's. (1934), Ltd.)	....	....	....	....	....	....	....	68,473·70	49,060·96	6,676·23
	5542z	Good Block Lease	....	....	....	....	....	....	7·32	1,491·00	2,319·67	....
	5747z	Guy Fawkes	....	....	38·00	22·03	....	....	....	38·00	22·03	....
	5759z	Janice Mary	....	....	14·00	5·35	....	....	....	14·00	5·35	....
	5714z	Lady Harriet North	....	....	....	....	....	....	....	21·00	4·01	....
	5549z	Lady Harriet	....	....	....	....	....	....	....	548·00	164·46	....

	5520z	Mignonette	....	....	....	....	....	....	....	478·50	345·92	....
	5749z	Woolgar	....	....	191·00	146·91	....	....	....	191·00	146·91	....
		Voided leases	....	....	....	....	....	45·42	1,125·41	934,265·50	725,625·37	13,586·39
		Sundry claims	....	....	159·75	90·58	....	49·50	597·55	32,690·44	24,866·47	776·49
Mt. Ida	5701z, etc.	Moonlight Wiluna G.M., Ltd.	....	....	11,211·00	5,609·78	502·83	....	....	11,211·00	5,609·78	502·83
	5701z, etc.	Prior to transfer to present holders	....	....	....	....	....	....	....	31,833·25	16,021·98	891·37
		Voided leases	....	....	....	....	....	....	92·21	68,731·17	72,679·14	106·63
		Sundry claims	....	....	147·00	40·99	....	48·14	406·19	15,965·91	8,149·90	·12
Twin Hills	....	Voided leases	....	....	....	....	....	....	....	582·30	574·93	....
		Sundry claims	....	....	....	....	....	....	....	97·80	86·69	....
	From District generally :—											
	Sundry Parcels treated at :											
	Gold Tailings, Ltd., Cyanide Plant	....	....	....	....	....	....	....	....	*345·87	5·84
	Lady Harriet Battery	....	....	....	*156·97	....	....	....	....	279·50	*18,053·74	30·00
	Mt. Ida State Battery	....	....	....	197·90	....	....	....	....	1,866·25	*7,100·02	·05
	P. W. Maher, L.T.T. 1130H	....	....	....	....	....	....	....	....	....	4·96	....
	P. W. Maher, L.T.T. 1100H	....	....	....	....	....	....	....	....	....	9·37	....
	C. Kirkham, L.T.T. 1106H	....	....	....	....	....	....	....	....	16·00	2·93	....
	B. W. Sanders Cyanide Plant, L.T.T. 1135H	....	....	....	*24·24	....	....	....	....	....	*62·28	46·39
	Sanders Cyanide Plant, L.T.T. 1107H	....	....	....	....	....	....	....	....	....	*241·76	224·87
	Various Works	....	....	....	....	....	....	....	....	2,512·30	38,206·49	2,754·98
	Reported by Banks and Gold Dealers	1·98	....	....	....	....	1,442·70	382·80	35·00	7·72	....
	Totals	**1·98**	....	**12,458·75**	**6,540·92**	**505·75**	**1,633·16**	**6,513·66**	**1,476,249·44**	**1,192,084·89**	**30,965·57**

ULARRING DISTRICT.

Davyhurst	1016U, 1085U	New Callion	....	....	717·00	253·09	....	....	....	6,010·30	2,245·66	119·67
		Voided leases	....	....	....	....	....	2·93	152·64	166,783·32	126,011·36	5,408·47
		Sundry claims	....	....	331·50	65·30	....	....	208·48	13,640·94	5,678·18	....
Morley's	1101U	Emerald	....	....	185·00	36·02	....	....	26·24	859·00	1,224·90	....
	1094U	First Hit	....	....	155·00	360·52	....	....	....	1,517·25	4,287·17	....
	1160U	Lancaster	....	....	50·00	88·80	....	....	....	50·00	88·80	....
	1081U	Mabel Gertrude	....	....	346·00	183·06	....	....	....	1,282·00	1,190·77	....
	1155U	Mountain Dew	....	....	15·00	4·17	....	....	....	67·00	20·91	....
	1089U	Paramount	....	....	225·00	95·65	....	....	....	2,331·50	2,268·52	....
	1078U	Rabbit	....	....	5·50	14·48	....	....	265·66	765·50	1,214·60	....
	1074U	Two Chinamen	....	....	22·00	6·52	....	....	3,466·48	1,589·50	3,844·90	10·54
		Voided leases	....	....	....	....	....	....	122·80	484·50	775·48	....
		Sundry claims	....	....	....	....	....	2·16	932·23	1,567·25	2,398·17	....
Mulline	1107U	Ajax West	....	....	685·50	852·30	....	....	1·37	1,268·25	1,945·47	....
	1070U	Riverina	....	....	47·00	22·12	....	....	....	82·00	29·30	....
	1070U, etc.	(Riverina Gold Mines Pty., Ltd.)	....	....	....	....	....	....	....	32,085·50	11,669·45	·07
	1154U	Shirley Patricia	....	....	....	....	....	....	....	7·00	2·23	....
		Voided leases	....	....	....	....	....	....	274·09	102,630·22	103,358·09	530·75
		Sundry claims	....	....	45·00	25·41	....	10·82	198·67	10,660·89	8,730·95	1·10

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
NORTH COOLGARDIE GOLDFIELD—*continued.*												
ULLARING DISTRICT—*continued.*												
Mulwarrie	1153U	Fourmile	....	....	10·50	56·86	....	....	....	28·50	178·35	....
	1113U	Oakley	....	....	300·00	380·34	....	....	....	1,179·50	1,356·46	....
		Voided leases	....	....	....	....	....	....	165·29	19,480·68	26,369·21	38·47
		Sundry claims	....	....	....	....	....	·80	282·29	3,102·33	2,704·43	....
Ularring	....	Voided leases	....	....	....	....	....	....	563·34	9,771·60	13,907·76	....
		Sundry claims	....	....	....	....	....	....	....	671·50	309·48	....
		From District generally :—										
		Sundry Parcels treated at :										
		State Battery, Mulline	....	....	....	....	....	....	....	639·99	*16,459·89	....
		State Battery, Mulwarrie	....	....	....	....	....	....	....	613·18	*6,564·16	....
		E. Rowe, M.A. 13U	....	....	....	....	....	....	....	....	21·65	....
		Two Chinamen Battery	....	....	....	*238·76	....	....	....	....	*548·28	....
		Waihi Battery	....	....	....	*65·28	....	....	....	5·00	*855·56	....
		Waihi Golden Pole Cyanide Plants	....	....	....	....	....	....	....	....	*936·58	....
		Prior to Amalgamation	....	....	....	....	....	....	....	....	*5,032·24	....
		Various Works	....	....	....	....	....	....	15·82	233·15	1,784·67	....
		Reported by Banks and Gold Dealers	....	....	....	·81	....	112·68	63·08	100·00	23·48	....
		Totals	....	....	3,140·00	2,749·49	....	129·39	6,738·48	379,507·35	354,046·91	6,109·07
NIAGARA DISTRICT.												
Desdemona		Voided leases	....	....	....	....	....	....	7·12	9,809·00	7,555·81	12·04
		Sundry claims	....	....	....	....	....	....	8·99	2,225·45	892·48	....
Kookynie	928G	Altona	....	....	420·25	504·58	....	....	....	1,042·50	1,191·61	....
	911G	Cosmopolitan South	....	....	268·00	115·32	....	....	....	1,743·00	814·38	....
	925G	New South Champion	....	....	90·00	55·45	....	....	....	360·00	472·26	....
		Voided leases	....	....	....	....	....	3·35	347·30	744,557·21	394,129·55	5,375·97
		Sundry claims	....	....	33·00	23·57	....	56·74	105·34	8,860·55	6,562·43	·18
Niagara		Voided leases	....	....	....	....	....	....	104·54	85,876·50	52,365·05	....
		Sundry claims	....	....	....	....	....	28·10	97·22	14,486·16	8,103·42	....
Tampa		Voided leases	....	....	....	....	....	....	41·58	50,477·57	23,287·71	174·24
		Sundry claims	....	....	....	....	....	32·60	283·40	8,041·33	4,113·02	....

			From District generally :—										
			Sundry Parcels treated at :										
			Owen Bros. Plant, M.A. 65G	....	....	....	....	....	....	....	....	*31·91	....
			Grafter Battery, Tampa	....	....	....	....	....	....	....	....	*137·63	....
			Niagara State Battery	....	....	....	....	....	....	....	....	*10·08	....
			Various Works	....	....	....	....	....	....	....	1,220·50	*16,226·67	41·17
			Reported by Banks and Gold Dealers	....	....	....	....	....	1,591·87	823·66	....	63·53	....
			Totals	....	....	811·25	698·92	....	1,712·66	1,819·15	928,699·77	515,957·54	5,603·60

YERILLA DISTRICT.

Edjudina	1011R, etc.	Paget Goldmines of Edjudina, Ltd.	....	....	....	....	....	....	....	841·50	187·51	....
		Prior to transfer to present holders	....	....	....	....	....	....	....	738·75	559·80	....
		Voided leases	....	....	....	....	....	....	18·44	33,943·45	42,627·48	37·79
		Sundry claims	....	....	....	....	....	....	26·89	6,887·58	4,806·37	....
Patricia	....	Voided leases	....	....	....	....	....	....	....	4,158·50	5,396·40	25·40
		Sundry claims	....	....	....	....	....	....	....	47·00	20·78	....
Pingin	....	Voided leases	....	....	....	....	....	....	48·34	17,463·30	10,742·77	....
		Sundry claims	....	....	12·00	4·84	....	....	154·86	5,635·59	3,471·54	....
Yarri	1320R	Margaret	....	....	33·00	8·83	....	....	....	352·00	102·03	....
	1126R, etc.	Porphyry (1939) G.M., N.L.	....	....	....	....	....	....	....	66,715·00	9,867·95	261·86
	1126R, etc.	Edjudina Gold Mining Co., N.L.	....	....	....	....	....	....	....	30,220·00	5,409·93	507·51
		Prior to transfer to present holders	....	....	....	....	....	....	....	124·50	38·89	....
	(1319R)	Valerie May	....	....	26·00	6·20	....	....	....	128·00	178·67	....
		Voided leases	....	....	....	....	....	6·30	87·08	44,196·75	21,056·75	2·00
		Sundry claims	....	....	418·50	97·66	·04	·87	5·93	15,986·55	5,861·05	·04
Yerilla	....	Voided leases	....	....	....	....	....	....	3,107·25	16,481·43	12,925·74	13·93
		Sundry claims	....	....	....	....	....	19·30	54·93	2,742·58	1,567·83	....
Yilgangie	1176R, etc.	Western Mining Corporation	....	....	1,738·00	1,545·83	175·18	....	....	4,317·75	4,796·33	286·66
		Prior to transfer to present holders	....	....	....	....	....	....	·85	1,244·75	1,830·28	....
		Voided leases	....	....	....	....	....	....	9·94	2,432·75	1,500·80	....
		Sundry claims	....	....	13·50	11·69	....	121·67	98·20	3,266·30	1,999·19	·63
		From District Generally :—										
		Sundry Parcels treated at :										
		State Battery, Yarri	....	....	....	*203·13	6·15	....	....	271·50	*8,141·13	9·65
		State Battery, Yerilla	....	....	....	....	....	....	....	....	*43·52	....
		Various Works	....	....	....	....	....	2·17	....	642·25	*6,049·24	....
		Reported by Banks and Gold Dealers	·23	....	....	18·98	....	1,161·60	160·08	....	23·09	....
		Totals	**·23**	....	**2,241·00**	**1,897·16**	**181·37**	**1,311·91**	**3,772·79**	**258,837·78**	**149,205·07**	**1,145·47**

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Broad Arrow Goldfield.												
Bardoc	....	Voided leases	....	....	....	....	....	....	2,335·41	85,370·59	55,699·50	203·60
		Sundry claims	....	....	241·00	47·80	....	54·95	1,194·11	16,131·28	7,906·99	....
Black Flag	2229w	Bellevue	....	....	189·00	392·32	....	....	44·80	621·00	1,127·07	....
		Voided leases	....	....	....	....	....	27·81	405·90	48,223·79	28,152·20	....
		Sundry claims	....	....	74·50	44·57	....	712·92	251·59	7,648·71	4,750·23	....
Broad Arrow	2039w	Golden Arrow	....	....	10·00	1·50	....	....	....	5,657·50	830·70	....
	2254w	Grace Darling Extended	....	....	311·00	128·74	....	....	....	700·50	362·43	....
	1771w	North Duke	....	....	....	....	....	....	1,670·51	236·80	634·35	....
		Voided leases	....	....	....	....	....	70·32	8,782·21	147,268·59	117,422·16	20·23
		Sundry claims	....	....	368·50	112·55	....	1,007·72	3,044·51	31,817·89	16,417·11	·11
Cane Grass	....	Voided leases	....	....	....	....	....	....	27·77	669·82	460·72	....
		Sundry claims	....	....	....	....	....	....	227·55	717·45	505·06	....
Carnage	....	Voided leases	....	....	....	....	....	176·04	659·31	2,402·00	2,170·67	....
		Sundry claims	....	....	....	....	....	....	6·61	1,840·08	874·56	....
Cashmans	....	Voided leases	....	....	....	....	....	67·51	813·76	8,172·15	7,090·91	....
		Sundry claims	....	....	6·35	5·28	....	....	40·31	1,157·87	338·24	·05
Christmas Reef	2262w	Gull's Neck	....	25·31	....	....	....	....	25·31	....	....	....
	2175w	New Mexico	....	....	148·75	862·11	....	....	....	1,058·35	3,376·21	....
		Voided leases	....	....	....	....	....	....	29·68	794·77	216·24	....
		Sundry claims	....	3·61	76·25	16·13	....	....	427·37	2,868·64	2,611·01	....
Fenbark	2188w	Golden Penny	....	....	102·00	38·38	....	....	....	2,750·50	594·83	....
		Voided leases	....	....	....	....	....	....	4·42	3,897·75	2,080·79	....
		Sundry claims	....	....	28·00	3·41	....	....	51·96	2,847·02	969·89	....
Grant's Patch	2261w	Bent Tree	....	....	254·00	42·67	....	....	....	254·00	42·67	....
	2242w	Lady Agnes	....	....	149·00	65·70	....	....	2·11	884·50	326·30	....
	2227w	Magpie	....	....	....	1·96	....	....	....	385·25	577·25	....
	1962w, etc.	Ora Banda Amalgamated Mines, N.L.	....	....	....	....	....	....	....	168,179·25	62,651·57	175·00
		Prior to transfer to present holders	....	....	....	....	....	....	....	12,424·50	9,540·07	....
	2208w	Wentworth	....	....	220·00	57·98	....	....	....	1,805·75	613·84	....
	2224w	Whip Pole	....	5·47	52·85	27·17	....	....	12·20	681·10	321·06	....
		Voided leases	....	....	....	....	....	....	258·52	14,783·10	4,672·25	....
		Sundry claims	....	....	42·25	39·52	....	....	356·66	5,870·54	2,931·18	....

Ora Banda	T.A. 42w, M.A. 41, etc.	Associated Northern Ora Banda, N.L.	....	....	....	3·77	....	....	....	2,786·50	457·22	21·07
		Prior to transfer to present holders	....	....	....	....	....	....	....	315,958·95	123,252·22	1,664·70
	1943, etc.	Ora Banda United Mines, Ltd.	....	....	....	....	....	....	....	2,545·75	136·91	....
		Prior to transfer to present holders	....	....	....	....	....	....	....	76,612·22	14,630·93	....
		Voided leases	....	....	....	....	....	....	845·72	24,580·60	12,604·69	....
		Sundry claims	....	....	159·50	24·30	....	....	336·76	12,865·00	4,294·87	....
Paddington	2266w	Colac	....	....	90·00	15·74	....	....	....	90·00	15·74	....
	2122w	Pakeha	....	....	401·75	208·42	....	....	....	3,267·65	1,190·62	....
	2263w	Try Again	....	....	32·75	7·19	....	....	....	32·75	7·19	....
		Voided leases	....	....	....	....	....	5,566·30	463·31	189,669·41	84,534·17	18·96
		Sundry claims	....	....	122·75	58·74	....	1,714·16	91·43	16,237·73	9,115·87	....
Riche's Find	2257w	Yalbalgo	....	....	....	....	....	....	....	76·00	328·30	....
		Voided leases	....	....	....	....	....	....	7·01	7,471·59	5,363·45	71·36
		Sundry claims	....	39·93	30·50	87·95	....	....	282·51	1,758·80	1,911·35	·13
Siberia	2248w	Beauty	....	....	....	....	....	....	....	53·00	217·34	....
		Voided leases	....	....	....	....	....	1·07	2,649·28	28,875·97	31,534·00	....
		Sundry claims	....	....	69·00	14·82	....	289·06	1,233·18	20,710·79	12,727·27	....
Smithfield	....	Voided leases	....	....	....	....	....	....	....	4,700·71	1,174·69	....
		Sundry claims	....	....	412·50	118·88	....	....	123·37	2,994·34	1,130·87	....
	From Goldfield Generally :—											
	Sundry Parcels Treated at :											
	State Battery, Ora Banda		....	....	....	*577·56	....	....	....	128·05	*20,595·83	....
	Golden Arrow Battery		....	....	....	*289·14	....	....	....	36·00	*3,815·40	....
	Ora Banda Tailings Syndicate Retreatment Works		....	....	....	....	....	....	....	....	*38·64	....
	Minnie Palmer Battery and Cyanide Plant		....	....	....	....	....	....	....	....	*3,082·62	....
	Various Works		....	....	....	....	....	2,275·66	1·24	16,967·02	*46,360·24	3,103·45
	Reported by Banks and Gold Dealers		7·25	....	....	....	....	9,979·56	131·39	61·68	90·35	....
	Totals		**7·25**	**74·32**	**3,592·20**	**3,294·30**	....	**21,943·08**	**27,037·78**	**1,306,601·55**	**714,878·84**	**5,278·66**

North-East Coolgardie Goldfield.

KANOWNA DISTRICT.

Gindalbie	1540x	Lady Betty	....	....	241·75	170·82	....	....	1,132·05	682·75	1,246·81	....
		Voided leases	....	....	....	....	....	....	19·94	44,322·53	39,596·70	38·31
		Sundry claims	....	....	80·75	7·26	....	....	716·52	4,995·02	2,795·10	....
Gordon	(1532x)	Sirdar	....	....	·07	2·39	....	....	92·66	4,838·67	3,425·83	517·61
		Voided leases	....	....	....	....	....	....	589·88	49,061·91	16,646·68	....
		Sundry claims	....	....	61·25	14·68	....	....	177·38	2,105·70	1,185·63	....
Kalpini	....	Voided leases	....	....	....	....	....	....	38·73	13,543·50	6,753·78	·07
		Sundry claims	....	....	....	....	....	24·70	269·72	1,492·50	1,026·37	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950. Alluvial. Fine ozs.	Dollied and Specimens. Fine ozs.	Ore treated. Tons (2,240 lb.).	Gold therefrom. Fine ozs.	Silver. Fine ozs.	Total Production. Alluvial. Fine ozs.	Dollied and Specimens. Fine ozs.	Ore treated. Tons (2,240 lb.).	Gold therefrom. Fine ozs.	Silver. Fine ozs.
NORTH-EAST COOLGARDIE GOLDFIELD—continued.												
KANOWNA DISTRICT—*continued.*												
Kanowna	1572x	Kanowna Red Hill	....	....	333·25	94·02	....	....	....	687·00	226·71	....
	1573x	Lady Robinson, North	....	1·07	13·00	6·01	....	....	1·07	13·00	6·01	....
		Voided leases	....	....	....	....	....	24·94	4,515·69	685,416·10	380,423·55	2,482·24
		Sundry claims	....	....	192·25	84·71	....	118·94	2,157·89	25,497·02	11,525·10	1·50
Mulgarrie	....	Voided leases	....	....	....	....	....	....	1,216·63	6,902·26	4,197·98	....
		Sundry claims	....	....	....	....	....	....	16·78	1,261·75	631·40	....
Six Mile	....	Voided leases	....	....	....	....	....	....	1,603·72	559·00	767·72	....
		Sundry claims	....	....	....	....	....	....	56·51	759·25	229·10	....
	From District Generally :—											
	Sundry Parcels treated at :											
	Various Works	....	....	....	....	....	....	330·42	867·52	158,935·05	*153,205·89	....
	Reported by Banks and Gold Dealers		4·97	....	....	....	....	105,998·74	36·91	·50	104·96	....
		Totals	**4·97**	**1·07**	**922·32**	**379·89**	....	**106,497·74**	**13,509·60**	**1,001,073·51**	**623,995·32**	**3,039·73**
KURNALPI DISTRICT.												
Jubilee	....	Voided leases	....	....	....	....	....	....	145·13	2,122·50	1,465·16	....
		Sundry claims	....	....	7·25	2·80	....	25·57	13·52	1,234·00	520·15	....
Kurnalpi	....	Voided leases	....	....	....	....	....	371·18	3,166·80	4,052·51	3,957·71	6·27
		Sundry claims	....	....	....	....	....	324·12	727·39	4,305·36	2,089·90	....
Mulgabbie	....	Voided leases	....	....	....	....	....	....	1,402·66	226·75	7,845·87	4·95
		Sundry claims	....	1·74	42·00	15·46	....	8·06	2,772·71	1,305·45	2,236·49	....
	From District Generally :—											
	Sundry Parcels treated at :											
	Various Works	....	....	....	....	....	....	....	....	101·50	*388·63	....
	Reported by Banks and Gold Dealers		·17	....	....	....	....	12,105·10	70·70	....	2·35	1·49
		Totals	**·17**	**1·74**	**49·25**	**18·26**	....	**12,834·03**	**8,298·91**	**13,348·07**	**18,506·26**	**12·71**

East Coolgardie Goldfield.

EAST COOLGARDIE DISTRICT.

Binduli	6025E	Belle of Kalgoorlie	....	....	117·25	6·99	....	....	....	644·75	76·09	....
		Voided leases	....	....	....	....	....	....	....	803·10	385·19	....
		Sundry claims	....	....	13·50	2·07	....	....	13·01	4,917·52	1,661·10	....
Boorara	5486E	Olympian	....	....	....	....	....	....	....	1,675·25	937·05	3·01
		Voided leases	....	....	....	....	....	....	459·07	306,930·82	171,842·83	408·36
		Sundry claims	....	....	234·25	33·43	....	·49	145·56	3,136·09	1,450·34	....
Boulder	6145E	Boomerang	....	....	....	....	....	....	....	77·00	8·00	....
	5690E	Boulder Perserverance, Ltd.	....	....	114,442·67	24,454·80	9,469·57	....	....	2,445,374·84	932,774·28	299,566·85
		Prior to transfer to present holders	....	....	....	....	....	....	....	3,306,942·88	1,841,159·00	203,821·43
	6077E	Brown Hill Consols	....	....	....	....	....	....	....	66·00	5·87	....
	5472E	Golden Key	....	1·55	....	....	....	18·27	24·33	432·25	165·02	....
	5159E, etc.	Gold Mines of Kalgoorlie, Ltd.	....	....	163,829·00	41,482·32	6,582·14	....	....	1,795,905·30	492,461·93	133,479·91
	5466E	(South Star)	....	....	....	....	....	....	233·46	4,237·43	1,494·78	....
	5466E	Prior to transfer to present holders	....	....	....	....	....	....	5·22	1,835·75	748·78	....
	5159E, etc.	(Lake View South (G.M.K.), Ltd.	....	....	....	....	....	....	....	62,278·38	21,536·66	....
	5692E, etc.	Prior to transfer to present holders	....	....	....	....	....	....	545·23	527,790·53	568,643·05	4,844·50
	5853E, etc.	(Paringa Junction North Leases)	....	....	....	....	....	....	7·82	1,686·79	701·11	....
	4366E, etc.	Great Boulder Pty. Gold Mines, Ltd.	....	....	331,739·00	79,826·91	33,559·77	....	1·53	9,440,284·97	5,125,068·48	1,028,781·80
	5845E	Happy Returns	....	....	1,063·00	189·16	....	....	....	3,559·25	703·16	....
	5345E, etc.	Kalgoorlie Enterprise Mines, Ltd.	....	....	46,939·85	14,417·00	1,267·37	....	....	700,286·34	218,083·17	21,021·59
		Prior to transfer to present holders	....	....	....	....	....	....	....	15,320·68	8,957·01	....
	4399E, etc.	Lake View and Star, Ltd.	....	....	525,924·00	126,748·41	21,863·95	....	....	9,280,864·30	2,988,441·27	271,518·20
		Prior to transfer to present holders	....	....	....	....	....	....	8·49	15792500·38	9,149,223·80	1,348,055·82
	6230E	New Look	....	....	104·75	6·70	....	....	....	150·50	13·68	....
	5405E, etc.	North Kalgurli (1912) Ltd. Croesus Pty. Group	....	....	....	....	....	....	51·20	90,159·00	19,261·22	....
	5431E, etc.	North Kalgurli (1912), Ltd.	....	....	241,365·84	59,424·59	12,097·20	....	111·55	2,583,227·67	839,370·39	216,533·52
	5891E	(New Croesus)	....	....	....	....	....	....	....	193·00	48·74	....
	5700E	Prior to transfer to present holders	....	....	....	....	....	43·99	....	4,018,436·01	2,815,911·21	97,625·03
	5429E	North Kalgurli United Mines, Ltd.	....	....	....	....	....	....	....	4,661·51	928·18	232·93
		Prior to transfer to present holders	....	....	....	....	....	....	....	131·74	76·74	....
	5853E	(Paringa Junction)	....	....	....	....	....	....	....	123·75	17·77	....
	5854E	(Paringa Junction North)....	....	....	....	....	....	....	....	60·50	10·64	....
	5855E	(Paringa Junction South)	....	....	....	....	....	....	....	1,473·25	228·42	....
	5434E, etc.	Paringa Mining and Exploration Co., Ltd.	....	....	96,488·00	17,058·28	3,154·70	....	....	1,119,455·30	258,805·49	22,242·80
		Prior to transfer to present holders	....	....	....	....	....	1·07	·79	57,618·03	24,452·83	....
	6095E	Raymond	....	....	....	....	....	....	....	115·50	17·89	....
	5695E, etc.	South Kalgoorlie Consolidated, Ltd.	....	....	90,093·90	21,278·99	332·39	....	....	2,815,550·63	1,061,272·46	26,198·97
		Prior to transfer to present holders	....	....	....	....	....	....	....	1,344,254·70	531,792·77	17,722·97
		Voided leases	....	....	....	....	....	109·90	11,998·25	626,615·98	473,927·47	6·83
		Sundry claims	....	....	....	....	....	24·58	210·25	11,539·99	4,267·18	....
Cutter's Luck	....	Voided leases	....	....	....	....	....	45·87	133·58	74·50	239·19	....
		Sundry claims	....	....	32·25	8·38	....	8·11	501·65	861·40	379·75	....
Feysville	....	Voided leases	....	....	....	....	....	....	110·93	561·30	394·24	....
		Sundry claims	....	....	83·00	20·18	....	....	199·00	1,200·10	640·27	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
EAST COOLGARDIE GOLDFIELD—continued.												
EAST COOLGARDIE DISTRICT—*continued.*												
Hampton Plains	P.P.L. 1, etc.	Consolidated Gold Areas, N.L.	....	....	....	....	....	....	....	140,704·23	37,087·38	5,835·85
	P.P.L. 23	Mutooroo	....	....	50·75	10·45	....	....	....	50·75	10·45	....
	P.P.L. 279	(Mutooroo)	....	....	....	....	....	....	....	6,151·88	1,087·26	....
	P.P.L. 9	Consolidated Gold Areas, N.L.	....	....	....	....	....	....	....	215·75	4·27	....
	P.P.L. 12	Junction Extended	....	....	....	....	....	....	....	3,581·75	527·74	....
	P.P.L. 55	R. J. Beavis	....	....	....	....	....	....	....	36·25	7·41	....
	P.P.L. 62	R. N. Innis	....	....	9·00	·95	....	....	....	9·00	·95	....
	P.P.L. 81	Villers Brettaneaux	....	....	....	....	....	....	....	3,562·02	1,435·55	....
	P.P.L. 86	Golden Hope, N.L.	....	....	....	....	....	....	....	5,964·00	2,006·14	....
	P.P.L. 153	Lone Pine	....	....	6·50	2·08	....	....	....	6·50	2·08	....
	P.P.L. 161	A. and D. Erceg	....	....	16·00	2·42	....	....	....	16·00	2·42	....
	P.P.L. 175	F. C. Schoppe	....	....	1,308·50	214·27	....	....	....	2,767·75	395·77	....
	P.P.L. 177	Great Northern	....	....	39·75	4·83	....	....	....	97·00	17·81	·23
	P.P.L. 192	Golden Hope North	....	....	....	....	....	....	....	353·00	201·02	....
	P.P.L. 227	J. McGrath	....	....	....	....	....	....	....	215·75	47·87	....
	P.P.L. 289	Mount Martin	....	....	173·00	42·84	....	....	....	173·00	42·84	....
	P.P.L. 289	(Mount Martin)	....	....	....	....	....	....	....	....	*157·41	....
	P.P.L. 252	Hampton Properties, Ltd., Mount Martin	....	....	....	....	....	....	....	14,953·75	5,574·11	....
	P.P.L. 277	New Hope	....	....	818·75	200·37	....	....	17·23	60,494·30	11,054·61	....
	P.P.L. 291	J. E. Trinidad	....	....	913·00	131·66	....	....	....	913·00	131·66	....
	P.P.L. 311	Dawn Hope	....	....	....	....	....	....	....	993·75	89·23	....
	P.P.L. 85	C. E. Andrews	....	....	59·75	8·79	....	....	....	59·75	8·79	....
	P.P.L. 207	Andrews and O'Riley	6·78	....	51·75	9·85	....	6·78	....	51·75	9·85	....
	P.P.L. 312	Andrews and O'Riley	6·12	....	104·50	12·22	....	6·12	....	104·50	12·22	....
	P.P.L. 371	Victory	....	....	43·00	7·85	....	....	....	1,760·50	232·32	....
		Cancelled leases	....	....	....	....	....	4,565·62	203·94	110,492·44	36,077·27	69·60
		Sundry claims and leases	....	....	....	....	....	2·68	70·85	46,386·16	8,494·60	....
Kalgoorlie	5927E	A.I.F.	....	....	24·75	2·41	....	....	....	55·75	12·75	....
	6048E	Auld Acquaintance	....	....	....	....	....	....	....	7·50	2·36	....
	5519E, etc.	Barbican Corporation, Ltd.	....	....	....	....	....	....	....	362·00	79·80	....
	5735E	Bonnie Lass	....	....	....	....	....	....	....	250·50	74·67	....
	5449E, etc.	The Broken Hill Pty. Co., Ltd.	....	....	39,166·00	9,255·95	....	....	3·99	477,744·01	175,699·51	1,843·28
		Prior to transfer to present holders	....	....	....	....	....	....	....	1,558·49	316·58	....
	5867E	Concord	....	....	....	....	....	....	8·64	184·75	67·72	....
	5839E	Coronation	....	....	....	....	....	....	....	40·00	9·03	....
	5913E	Devon Consols	....	....	184·25	55·55	....	....	93·19	1,819·71	604·84	....
	5924E	Federal	....	....	....	....	....	....	....	36·25	4·51	....
	5737E	Golden Mile Channel	....	....	....	....	....	....	·97	2,677·25	207·65	....

	5878E	Lady May	....	....	141·25	34·30	....	....	62·05	3,105·25	1,029·05	....
	6091E	Lesanben	....	20·38	14·75	55·54	....	....	144·36	71·00	170·47	....
	4547E, etc.	Mount Charlotte (Kalgoorlie) Gold Mines, Ltd.	....	....	1,157·50	51·83	....	....	....	2,391·50	304·00	....
		Prior to transfer to present holders	....	....	....	....	....	....	5·72	48,292·60	13,930·79	....
	5437E	North End Extended	....	....	....	....	....	....	996·89	367·85	528·94	....
	5852E, etc.	Pedestal Leases	....	....	237·50	71·33	....	....	....	937·75	226·35	....
	6024E	(Trident)	....	....	....	....	....	....	....	58·75	36·67	....
	5852E	(Pedestal)	....	....	....	....	....	....	....	1,608·75	444·93	....
	5468E	Phar Lap	....	....	10·25	6·23	....	....	....	497·75	358·80	....
	5415E, etc.	Return Leases	....	....	77·75	4·87	....	....	5·64	3,801·25	654·34	....
	5933E, etc.	Sceptre Leases	....	....	....	....	....	....	....	28·00	4·63	....
		Voided leases	....	....	....	....	....	242·48	9,561·63	964,592·95	397,763·68	44,017·12
		Sundry claims	....	....	199·00	38·97	....	232·41	1,122·17	59,487·83	22,998·38	....
Wombola	6051E	Big Bull	....	....	129·50	56·74	....	....	....	413·00	296·06	....
	5688E, etc.	Caledonian Leases	....	....	....	....	....	....	....	543·00	247·27	....
	5688E	(Caledonian)	....	....	....	....	....	....	....	4,275·00	3,632·98	....
	5967E	(North Caledonian)	....	....	....	....	....	....	1·27	22·25	8·15	....
	5497E, etc.	Daisy Leases	....	....	682·70	429·34	....	....	....	2,696·95	1,762·14	5·92
	5497E	(Daisy)	....	....	....	....	....	....	....	6,282·25	5,031·93	....
	5500E	(Happy-Go-Lucky)	....	....	....	....	....	....	....	2,075·25	1,675·85	....
	6032E	Dry Mount	....	....	499·00	259·97	....	....	....	1,003·00	1,096·93	....
	4766E	Great Hope	....	....	....	....	....	....	....	96·00	28·09	....
	4766E	(Pericles Gold Mines, Ltd.)	....	....	....	....	....	....	358·11	4,728·03	19,305·86	....
	5525E, etc.	Haoma Leases	....	....	1,279·00	1,001·84	....	....	....	10,516·50	7,214·53	....
	5689E	(Haoma)	....	....	....	....	....	....	....	2,168·00	1,948·36	....
	5525E	(Xmas Flat)	....	....	....	....	....	....	....	330·25	264·74	....
	6250E	Hill Billy	....	....	16·50	7·54	....	....	....	16·50	7·54	....
	6043E	Launa Doone	....	....	131·50	51·39	....	....	....	1,095·00	465·78	....
	6043E, etc.	(Launa Doone Leases)	....	....	....	....	....	....	....	32·50	42·76	....
	5961E	Loganberry	....	....	....	....	....	....	....	288·25	101·02	....
	6224E	Lucky Strike	....	....	41·00	7·69	....	....	....	71·00	13·79	....
	5798E	Maranoa	....	....	331·00	109·77	....	....	32·17	3,183·50	1,633·27	....
	5493E, etc.	New Milano, N.L.	....	....	....	....	....	....	·25	17,390·75	11,622·24	479·00
	5493E	(Milano)	....	....	....	....	....	....	....	4,012·75	11,676·72	....
	5616E	(Leslie)	....	....	....	....	....	....	....	602·00	939·10	....
	6213E	Pauline	....	....	144·00	112·31	....	....	....	195·00	196·39	....
	6237E	Proprietary	....	....	108·00	188·55	....	....	....	108·00	188·55	....
	5866E	Rosemary	....	....	....	....	....	....	....	53·50	84·73	....
		Voided leases	....	....	....	....	....	....	2,106·67	21,560·56	20,294·60	....
		Sundry claims	....	....	534·25	194·62	....	....	711·10	22,583·43	13,855·12	....
	From District generally :—											
	Sundry claims	....	....	....	....	....	11,014·57	465·61	5,440·46	2,541·10	....
	Sundry Parcels treated at :—											
	L.T.T. 1120H, B.H.P., Kalgoorlie	....	....	....	*263·71	....	....	....	....	*524·32	....
	L.T.T. 1092H, J. J. Cavalier	....	....	....	*17·45	....	....	....	10·50	*198·47	....
	Prior to transfer to present holders	....	....	....	....	....	....	....	....	*1,538·16	1,507·65
	T.Ls. 101, etc., Golden Horseshoe (New), Ltd.	....	....	....	*7,661·15	11,627·62	....	....	....	*304,059·36	311,513·73
	Pericles Cyanide Plant	....	....	....	*62·93	....	....	....	....	*3,632·12	....
	Polkinghornes Cyanide Plant	....	....	....	....	....	....	....	....	*149·38	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950. Alluvial. Fine ozs.	Dollied and Specimens. Fine ozs.	Ore treated. Tons (2,240 lb.).	Gold therefrom. Fine ozs.	Silver. Fine ozs.	Total Production. Alluvial. Fine ozs.	Dollied and Specimens. Fine ozs.	Ore treated. Tons (2,240 lb.).	Gold therefrom. Fine ozs.	Silver. Fine ozs.
EAST COOLGARDIE GOLDFIELD—continued.												
EAST COOLGARDIE DISTRICT—*continued.*												
		M.A. 1, J. F. Poynton's Plant	....	....	....	...	....	....	....	9·50	6·06	....
		State Battery, Kalgoorlie	....	....	....	*1,119·02	....	....	....	345·70	*26,154·74	39·40
		Various Works	....	....	....	....	....	384·36	64·70	41,115·02	*264,211·65	12,606·81
		Reported by Banks and Gold Dealers	43·66	2·83	·01	1,110·43	....	16,820·66	9,958·83	355·66	5,564·99	....
		Totals	**56·56**	**24·76**	**1,661,173·97**	**407,838·22**	**99,954·71**	**33,527·96**	**40,756·90**	**58497725·99**	**28991048·83**	**4,069,983·11**
BULONG DISTRICT.												
Balagundi	....	Voided leases	....	....	....	....	....	....	2,408·98	1,110·68	1,473·73	12·92
		Sundry claims	....	1·61	8·00	13·74	....	3·51	293·52	777·51	498·71	....
Bulong	1311Y	Blue Quartz	....	....	191·75	114·37	....	....	....	975·75	328·61	....
	1308Y	Southern Cross	....	....	480·50	54·97	....	....	1·30	3,183·00	514·76	....
		Voided leases	....	....	....	....	....	107·54	8,524·82	104,806·80	85,230·44	....
		Sundry claims	....	....	165·25	32·24	....	1,655·86	1,607·89	15,294·98	17,554·11	....
Majestic	....	Voided leases	....	....	....	....	....	19·45	63·91	1,317·94	647·62	....
		Sundry claims	....	....	....	....	....	42·88	154·58	1,926·55	948·06	....
Morelands	....	Sundry claims	....	....	....	....	....	....	·13	308·75	81·84	....
Mount Monger	....	Voided leases	....	....	....	....	....	....	2,771·39	1,437·85	1,256·10	....
		Sundry claims	....	....	....	....	....	215·60	....	379·05	308·48	....
Randalls	....	Voided leases	....	....	....	....	....	....	60·04	33,180·35	11,100·46	....
		Sundry claims	....	....	....	....	....	20·70	8·11	4,814·31	1,211·05	....
Taurus	....	Voided leases	....	....	....	....	....	2·06	3·70	1,765·10	909·84	....
		Sundry claims	....	....	....	....	....	112·69	51·88	2,608·35	1,037·88	....
Hampton Plains	P.P.L. 308A	Dawn of Hope	....	....	....	....	....	....	2·87	1,141·50	328·80	....
Trans. Find	1319Y	Two H's.	....	....	83·75	7·73	....	....	....	83·75	7·73	....
	1320Y	Two H's. South	....	....	30·75	2·78	....	....	....	30·75	2·78	....
		Voided leases	....	....	....	....	....	....	....	983·92	865·71	....
		Sundry claims	....	....	13·00	4·61	....	....	5·93	808·25	335·33	....

From District generally :—												
Various Works	....	....	....	....	....	....	....	....	6,102·15	*6,675·38	....
Reported by Banks and Gold Dealers	17·20	....	....	....	....	25,215·32	70·15	·01	28·44	....
Totals	**17·20**	**1·61**	**973·00**	**230·44**	....	**27,395·61**	**16,029·20**	**183,037·30**	**131,345·86**	**12·92**

Coolgardie Goldfield.

COOLGARDIE DISTRICT.

Bonnievale	5596 (5816) (5817) (5818)	Coolgardie Gold Mines, Ltd.	....	....	195·53	98·71	·88	....	....	770·33	461·77	1·71
	5596	(Jenny Wren)	....	....	....	....	....	....	182·45	989·30	1,165·40	4·17
	5622	Lucky Hit	....	....	38·50	22·95	....	....	....	905·85	460·38	....
	4600	Melva Maie	....	....	123·75	29·03	·65	....	....	2,193·15	3,543·46	2·35
		Prior to transfer to present holders	....	....	....	....	....	....	....	614·50	1,099·21	11·63
	5767, 5768	Victory Explorations, N.L.	....	....	1,039·50	242·29	....	....	....	1,973·50	402·12	....
	5767	(Red Ridge)	....	....	....	....	....	....	....	108·00	53·63	....
		Voided leases	....	....	....	....	....	....	30·03	352,675·34	188,804·77	....
		Sundry claims	....	....	122·50	105·98	....	....	161·29	6,354·93	4,701·49	....
Bulla Bulling	....	Voided leases	....	....	....	....	....	....	....	776·81	668·19	....
		Sundry claims	....	....	....	....	....	5·21	15·98	1,318·26	561·29	....
Burbanks	5677, etc.	Burbanks Bonnievale Prospecting Co., Ltd.	....	....	2,576·00	833·49	....	....	....	2,576·00	833·49	....
	5605	Burbanks Deeps	....	....	....	....	....	....	....	103·00	53·46	....
	5443	New Gift	....	....	....	....	....	....	2·00	625·50	228·69	....
		Voided leases	....	....	....	....	....	14·90	372·17	415,782·21	304,621·08	521·06
		Sundry claims	....	2·33	120·75	14·13	....	55·05	479·44	15,012·55	8,679·24	....
Cave Rocks	5645	Gold Coin	....	....	1,031·89	184·41	....	....	....	4,118·36	881·60	....
	(5833)	Squeaker	....	....	541·25	158·85	....	....	....	967·75	300·21	....
	5793	Two Cees	....	....	....	....	....	....	....	56·00	9·01	....
		Voided leases	....	....	....	....	....	....	....	3,081·05	750·60	....
		Sundry claims	....	....	42·25	4·36	....	....	50·00	4,266·15	1,019·84	....
Coolgardie	5679	Ada	....	....	....	....	....	....	....	1,130·25	107·11	....
	(5637)	Caledonia	....	....	96·00	20·73	....	....	7·30	2,744·25	517·89	....
	5297, etc.	Consolidated Gold Mines of Coolgardie, Ltd.	....	....	....	....	....	....	....	282,560·70	50,610·27	4,812·12
		Prior to transfer to present holders	....	....	....	....	....	....	4·55	1,946·35	547·45	3·22
	5653	Gleesons	....	....	....	....	....	....	....	1,925·00	922·37	....
	5844	Jackpot	....	....	413·00	173·69	....	....	....	413·00	173·69	....
	5598	King Solomon	....	....	....	....	....	2·69	....	856·25	129·66	....
	(5713)	Lady Grace	....	....	100·00	15·64	....	....	....	386·75	249·08	....
	5643	Lloyd George South	....	....	....	....	....	....	....	....	10·25	....
	5743	Moya Jan	....	....	50·50	14·10	....	....	....	1,545·50	610·52	....
	5256, etc.	Phoenix Gold Mines Pty., Ltd.	....	....	....	....	....	....	....	240,385·00	66,736·54	2·54
		Prior to transfer to present holders	....	....	....	....	....	....	2·74	167·56	237·80	....
	(5850)	Tania	....	....	102·75	34·16	....	....	....	102·75	34·16	....
		Voided leases	....	....	....	....	....	1,299·02	4,660·89	573,360·68	327,527·64	1·02
		Sundry claims	....	21·64	1,063·75	255·58	....	205·49	2,703·41	67,954·10	25,010·09	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
COOLGARDIE GOLDFIELD—continued.												
COOLGARDIE DISTRICT—*continued.*												
Eundynie	5853	Crystal Contact	2·78	....	4·78	26·43	....	2·78	....	4·78	26·43	....
	5624	Eundynie	....	....	....	....	....	....	....	54·00	76·35	....
		Voided leases	....	....	....	....	....	·92	16·09	31,697·20	16,423·28	1·75
		Sundry claims	....	72·10	12·75	30·97	....	....	82·28	682·62	464·56	....
Gibraltar	5723	Lloyd George	....	....	....	....	....	....	....	570·00	105·54	....
	5684	Winston Churchill	....	....	....	....	....	....	....	60·00	12·96	....
		Voided leases	....	....	....	....	....	....	33·97	38,592·63	20,097·49	....
		Sundry claims	....	....	49·50	4·22	....	1·39	50·76	3,256·45	1,336·79	....
Gnarlbine	....	Voided leases	....	....	....	....	....	....	13·95	2,731·75	1,341·60	....
		Sundry claims	....	....	....	....	....	....	4·90	1,186·10	504·18	....
Hampton Plains	P.P.L. 419	Chatanooka	....	....	66·50	12·26	....	....	....	1,267·75	295·73	1·10
	P.P.L. 328	Daniel Finn	....	....	....	....	....	....	....	19·75	11·18	....
	P.P.L. 338	Dry Hill	....	....	....	....	....	....	....	43·00	58·42	....
	P.P.L. 427	Easter Gift	....	....	....	....	....	....	....	21·75	3·04	....
	P.P.L. 119	Golden Eagle	....	....	....	....	....	....	7·63	2,807·59	2,548·42	....
	P.P.L. 348	Hampton Gold Mining Areas, Ltd.	....	....	....	....	....	....	....	43·75	4·69	....
	P.P.L. 348	Goldfields Australian Development Co., Ltd.	....	....	....	....	....	....	....	78·00	12·89	....
	P.P.L. 334, 448	Hampton Gold Mining Areas, Ltd.	....	....	....	....	....	....	....	1,538·25	453·60	....
	P.P.L. 454	Golden Dollar	....	....	....	....	....	....	....	48·75	7·53	....
	P.P.L. 435	Lady Jess	....	....	....	....	....	....	2·79	151·00	30·47	....
	P.P.L. 355	Lady Marie	....	....	100·50	4·55	....	....	....	545·50	118·33	....
	P.P.L. 319	Lady May	....	....	....	....	....	....	....	1,742·25	981·39	....
	P.P.L. 389	Lassie Come Home	....	....	....	....	....	....	....	30·00	6·54	....
	P.P.L. 458	Mac	....	....	....	....	....	....	....	11·00	60·85	....
	P.P.L. 315	Malvern Star	....	....	....	....	....	....	....	16·00	10·14	....
	P.P.L. 436	May	....	....	....	....	....	....	....	4·50	1·35	....
	P.P.L. 429	Maureen Anne	....	....	....	....	....	....	....	14·75	2·15	....
	P.P.L. 430	Melba	....	....	....	....	....	....	....	10·00	3·51	....
	P.P.L. 361	Mistletoe	....	....	....	....	....	....	....	20·00	5·11	....
	P.P.L. 316, 330	New Coolgardie Gold Mines, N.L.	....	....	32,154·00	16,429·32	2,290·38	....	....	56,216·00	25,728·18	3,653·91
	P.P.L. 316	(Surprise G.M.)	....	....	....	....	....	....	....	7,189·00	3,425·59	....
	P.P.L. 330	(Barbara)	....	....	....	....	....	....	....	2,157·75	1,655·63	....
	P.P.L. 437	Two Crows	....	....	....	....	....	....	....	15·00	5·57	....
		Cancelled leases	....	....	....	....	....	....	403·05	8,518·25	7,798·76	....
		Sundry claims and leases	....	....	....	....	....	1·63	132·06	1,738·25	799·38	....

Higginsville	5647	Fair Play Gold Mine	....	....	5,726·00	471·91	....	....	....	28,276·00	3,123·82	·02
	5293	Two Boys	....	....	....	*138·60	....	....	....	460·00	*1,178·27	·01
	5293	(Two Boys)	....	....	....	....	....	....	....	6,888·00	3,193·95	....
		Voided leases	....	....	....	....	....	....	373·93	38,141·35	17,438·49	159·50
		Sundry claims	....	....	....	....	....	....	187·25	3,638·26	1,942·64	....
Larkinville	....	Voided leases	....	....	....	....	....	22·77	54·44	2,335·16	3,256·49	....
		Sundry claims	....	....	....	....	....	....	147·20	448·53	1,029·03	....
Logans	5324, etc.	Spargo's Reward Gold Mine (1935), N.L.	....	....	....	....	....	....	....	105,397·50	26,320·67	....
		Voided leases	....	....	....	....	....	....	....	1,263·31	607·26	....
		Sundry claims	6·88	....	....	....	....	6·88	128·95	1,881·35	888·61	....
Londonderry	....	Voided leases	....	....	....	....	....	....	95·04	34,155·35	22,238·37	·35
		Sundry claims	....	....	....	....	....	16·68	38·72	3,199·17	2,446·94	22·42
Mungari	....	Voided leases	....	....	....	....	....	....	17·71	1,872·50	458·43	....
		Sundry claims	....	....	44·75	7·96	....	1·77	153·24	2,488·19	705·11	....
Paris	5311, 5500	Lister's Gold Mine	....	....	80·00	16·83	....	·88	....	5,360·00	3,506·79	75·95
	5311, 5500, 5530	(Lister's Gold Mine)	....	....	....	....	....	....	....	8,582·00	4,423·84	....
	5500	(Paris Central)	....	....	....	....	....	....	....	113·00	24·16	....
		Voided leases	....	....	....	....	....	....	4·30	1,342·00	614·08	3·24
		Sundry claims	....	....	....	3·66	....	....	....	2,104·25	518·98	....
Red Hill	....	Voided leases	....	....	....	....	....	14·87	1,551·81	40,797·40	31,070·65	....
		Sundry claims	....	....	....	....	....	15·29	90·33	1,403·02	724·13	....
Ryan's Find	....	Voided leases	....	....	....	....	....	....	....	54·16	151·69	....
		Sundry claims	....	....	....	....	....	....	·44	116·44	355·83	....
St. Ives	5628, etc.	Ives Reward Leases	....	....	....	....	....	....	....	1,617·00	450·47	....
		Voided leases	....	....	....	....	....	63·34	146·87	37,701·46	15,756·31	....
		Sundry claims	....	....	....	....	....	211·25	944·85	4,158·56	1,453·58	....
Wannaway	....	Voided leases	....	....	....	....	....	....	28·61	1,831·95	1,465·70	....
		Sundry claims	....	....	10·55	25·02	....	....	193·79	1,316·37	1,300·33	....
Widgiemooltha	5794	Bluebird	....	24·58	·10	47·52	....	....	136·36	39·39	110·25	....
	5663	Bobs	....	....	....	....	....	....	....	16·00	4·94	....
	5702	Cardiff Castle	....	....	....	....	....	....	....	1,757·05	442·31	....
	5834	Harpers	....	....	....	....	....	....	....	7·00	28·25	....
	5451	Host Group	....	....	....	....	....	....	12·75	1,602·80	524·21	....
	5815	Warren N.	8·53	....	....	....	....	8·53	....	....	....	....
		Voided leases	....	....	....	....	....	9·42	1,114·94	20,930·07	11,401·42	·17
		Sundry claims	....	....	170·30	34·07	....	46·49	456·07	16,041·41	6,775·77	·07
	From District Generally :—											
	Sundry Parcels treated at :											
	State Battery, Coolgardie	....	....	....	*977·90	....	....	....	....	771·01	*35,725·69	9·65
	Terrell and Party, T.A. 201	....	....	15·00	*71·55	....	....	....	....	15·00	*71·55	....
	Australian Machinery and Investment Co., Ltd., Cyanide Plant, T.L.'s 63, 127	....	....	....	....	....	....	....	....	....	*3,044·44	86·31
	Ajax Treatment Plant, M.A. 97	....	....	....	....	....	....	....	....	....	*43·26	....

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
COOLGARDIE GOLDFIELD—continued.												
COOLGARDIE DISTRICT—*continued.*												
		Listers Cyanide Plant	....	....	....	....	....	....	....	....	*269·23	....
		Paris Central Cyanide Plant	....	....	....	....	....	....	....	....	*77·64	....
		N. C. Parry Cyanide Plant, M.A. 96	....	....	....	....	....	....	....	....	*23·77	....
		Widgiemooltha Cyanide Plant, M.A. 85	....	....	....	....	....	....	....	....	*1,165·31	....
		Various Works	....	....	....	....	....	7·75	....	3,897·61	*28,149·90	223·06
		Reported by Banks and Gold Dealers	18·45	....	....	....	....	14,852·43	718·84	48·25	74·95	·60
		Totals	**36·64**	**120·65**	**46,092·65**	**20,510·87**	**2,291·91**	**16,867·43**	**16,016·17**	**2,535,887·92**	**1,311,738·59**	**9,597·93**
KUNANALLING DISTRICT.												
Carbine	970s	Carbine	....	....	....	....	....	....	....	13,820·00	7,047·96	....
	970s, etc.	(Carbine Leases)	....	....	....	....	....	....	687·98	51,991·86	39,862·25	....
		Voided leases	....	....	....	....	....	....	....	20,116·00	5,470·81	....
		Sundry claims	....	....	78·50	12·73	....	136·08	93·96	6,010·78	2,025·48	....
Chadwin		Voided leases	....	....	....	....	....	....	....	4,781·55	5,232·25	2·50
		Sundry claims	....	....	30·50	8·18	....	14·28	78·02	5,924·05	2,923·42	·25
Dunnsville		Voided leases	....	....	....	....	....	....	828·58	17,548·85	8,657·45	....
		Sundry claims	....	....	62·30	39·52	....	3·35	1,034·08	2,646·56	1,995·20	....
Jourdie Hills		Voided leases	....	....	....	....	....	....	18·00	28,009·74	19,401·09	28·45
		Sundry claims	....	....	8·00	5·50	....	1·86	49·81	1,681·00	824·75	1·05
Kintore	1036s	Newhaven	....	....	210·50	49·32	....	....	....	1,045·50	278·13	....
		Voided leases	....	....	....	....	....	18·70	169·33	54,829·39	39,579·50	677·88
		Sundry claims	....	....	337·00	52·48	....	111·91	102·70	4,320·63	2,387·25	....
Kunanalling		Voided leases	....	....	....	....	....	86·13	1,734·92	130,303·61	100,812·73	40·77
		Sundry claims	....	7·16	173·75	65·62	....	216·53	815·28	14,395·92	9,467·98	....
Kundana		Voided leases	....	....	....	....	....	....	....	465·00	68·12	....
		Sundry claims	....	....	12·00	1·45	....	....	....	443·50	51·82	....

From District Generally :—													
Sundry Parcels treated at :													
Goldfields Australian Development Cyanide Plant	....	....	....	....	....	....	....	....	....	....	*548·07	....
Various Works	....	....	....	....	....	42·23	....	....	1,782·26	*5,061·33	....	
Reported by Banks and Gold Dealers	3·16	....	....	....	....	864·60	17·93	....	5·85		·49	
Totals	**3·16**	**7·16**	**912·55**	**234·80**	....	**1,495·67**	**5,630·59**	**360,116·20**	**251,701·44**	**751·39**		

Yilgarn Goldfield.

Blackbornes	....	Voided leases	....	....	....	....	....	....	....	1,282·50	341·37	....	
		Sundry claims	....	....	....	....	....	....	....	392·50	81·15	....	
Bullfinch	3345, etc.	Copperhead	....	....	....	....	....	....	....	7,427·32	2,076·32	....	
	3378, etc.	Copperhead Deeps	....	....	....	....	....	....	....	13,554·65	4,102·83	....	
	3337, etc.	Easter Gift Leases	....	....	....	....	....	....	....	1,597·00	472·43	....	
		Prior to transfer to present holders	....	....	....	....	....	....	48·03	3,594·26	11,69·82	....	
	3400	Frances May	....	....	....	....	....	....	7·74	8,683·55	3,341·69	....	
	3397	Goldfinch	....	....	....	....	....	....	6·73	6,488·03	2,643·99	....	
	4287	Volcano	....	....	26·00	34·01	....	....	....	26·00	34·01	....	
	3350	Rising Sun	....	....	....	....	....	....	2·30	37,059·53	10,837·80	....	
		Voided leases	....	....	....	....	....	....	10·14	490,361·07	185,489·03	27,958·41	
		Sundry claims	....	....	10·00	22·81	....	8·47	37·04	7,348·75	3,996·34	....	
Corinthian	3398, 3425	Corinthian Leases	....	....	....	....	....	....	....	3,081·83	1,770·09	....	
	3398	(Corinthian)	....	....	....	....	....	....	....	7,383·75	2,543·16	....	
	3425	(Corinthian, North)	....	....	....	....	....	....	....	3,951·00	1,934·78	....	
	4180	Deliverance	....	....									
		Voided leases	....	....	153·00	40·26	....	....	....	480·00	167·55	....	
		Sundry claims	....	....	....	....	....	....	23·46	138,241·40	33,293·21	....	
					....	....	....	....	2·68	1,088·35	640·61	....	
Eenuin	4020	Birthday	....	....	....	....	....	....	2·25	45·00	194·94	·01	
	4129	Birthday West	....	....	138·00	14·85	....	....	....	195·00	48·97	....	
	4042	Birthday South	....	....	14·00	1·40	....	....	1·03	65·00	58·94	....	
	(4246)	Lone Pine	....	....	15·00	6·27	....	....	....	39·00	14·77	....	
	4321	Syncline	....	....	29·00	3·52	....	....	....	29·00	3·52	....	
	3936	Newfield Central	....	....	....	....	....	....	....	343·00	526·82	....	
	3936, etc.	(Yellowdine Gold Areas, N.L.)	....	*	....	....	....	....	....	7,341·50	7,605·06	....	
		Voided leases	....	....	....	....	....	....	178·46	1,980·56	2,004·90	....	
		Sundry claims	....	....	27·00	23·34	....	2·50	73·97	2,423·60	1,709·04	....	
Evanston	3868, etc.	Evanston Gold, N.L.	....	....	....	5·57	....	....	....	12,333·20	5,389·33	....	
	3868	(Evanston)	....	....	....	....	....	....	....	48,125·30	25,848·30	10·14	
	3870	(Evanston, East)	....	....	....	....	....	....	....	34·00	13·59	....	
	3888	(Goldies)	....	....	....	....	....	....	....	200·00	43·15	....	
	3895	(Blue Peter)	....	....	....	....	....	....	....	1,288·00	285·84	....	
	3997	Gravel Pit	....	....	....	....	....	....	79·27	238·80	160·25	....	
		Voided leases	....	....	....	....	....	....	....	2,247·76	1,310·63	....	
		Sundry claims	....	....	....	....	....	4·98	....	638·35	159·55	....	
Forrestonia	....	Voided leases	....	....	....	....	....	....	....	1,185·00	298·15	....	
		Sundry claims	....	....	....	....	....	....	....	372·00	141·78	....	

Table I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
YILGARN GOLDFIELD—continued.												
Golden Valley	4173	Inspiration	....	....	32·00	43·23	....	....	....	136·00	209·49	....
	4247	Lily of the Valley	....	....	....	....	....	....	....	160·00	33·50	....
	2994, etc.	Radio Leases	....	....	1,405·00	1,330·70	115·14	....	2·70	24,305·80	45,534·43	608·07
	(3248)	Radio Deeps	....	....	20·00	8·57	....	....	....	20·00	8·57	....
		Voided leases	....	....	....	....	....	....	36·34	36,525·92	28,500·83	10·99
		Sundry claims	....	....	98·00	49·42	....	4·58	237·85	6,627·27	4,896·68	1·02
Greenmount	72PP	Black and White	....	....	40·00	4·68	....	....	....	40·00	4·68	....
		Voided leases	....	....	....	....	....	45·99	21·62	125,022·64	31,575·09	944·50
		Sundry claims	....	....	59·00	14·98	....	·46	4·27	3,048·58	809·31	....
Holleton	37PP	Brittania	....	....	250·00	208·26	....	....	....	1,156·00	1,119·02	....
	4169	Holleton, East	....	....	....	4·58	....	....	....	160·00	35·94	·15
		Voided leases	....	....	....	....	....	....	9·33	44,700·25	13,037·52	34·53
		Sundry claims	....	....	....	....	....	....	3·75	3,464·05	923·78	·20
Hope's Hill	3414	Pilot	....	....	....	....	....	....	....	19,446·12	2,948·68	....
		Voided leases	....	....	....	....	....	....	74·78	132,617·55	36,457·49	1·00
		Sundry claims	....	....	27·00	7·25	....	18·67	44·35	4,562·02	1,411·04	....
Kennyville	3875	Victoria	....	....	125·00	29·12	....	....	....	4,513·00	1,030·95	·63
		Voided leases	....	....	....	....	....	....	18·76	55,876·63	21,625·66	·59
		Sundry claims	....	....	....	2·15	....	....	5·06	8,498·50	2,284·63	....
Koolyanobbing	....	Voided leases	....	....	....	....	....	....	·99	1,768·05	972·77	....
		Sundry claims	....	....	....	....	....	·26	1·21	656·10	329·20	....
Marvel Loch	3987, etc.	Burbidge Gold Mines, N.L.	....	....	25,400·00	1,265·30	....	....	....	185,172·00	15,166·95	....
	3987	(Grand National)	....	....	....	....	....	....	....	19,739·00	2,647·30	....
	4243	Christmas Gift	....	....	23·00	37·07	....	....	1·82	23·00	37·07	....
	3957	Comet	....	....	....	....	....	....	....	1,199·50	677·52	6·85
	13 P.P.	Cricket	....	....	39·00	7·42	....	....	....	1,655·00	929·17	....
	4039	Cromwell	....	....	....	....	....	....	....	370·00	56·29	....
	3942, etc.	Edward's Reward Leases	....	....	3,749·00	1,627·85	....	....	....	38,367·50	17,773·90	....
	3942	(Edward's Reward)	....	....	....	....	....	....	....	2,080·00	2,016·32	....
	3943	(Sunshine)	....	....	....	....	....	....	....	3,866·00	2,384·79	....
	4323	Emanbe	....	....	125·00	10·18	....	....	....	125·00	10·18	....
	4034	Firelight	....	....	4,287·00	419·22	....	....	....	6,256·00	902·76	....
	4291	Four Threes	....	....	204·00	16·24	....	....	....	204·00	16·24	....
	3724	Frances Firniss	....	....	515·50	329·21	....	....	....	10,788·50	4,837·48	....
	4254	Golden Cube	....	....	42·00	4·13	....	....	....	42·00	4·13	....

	3718	Kurrajong	....	....	....	....	....	....	....	9,221·00	3,271·73	....
	3914	May	....	....	....	....	....	....	....	145·00	45·86	....
	4230	May Queen	....	....	276·00	33·04	....	....	....	276·00	33·04	....
	3970	Mountain Queen	....	....	540·00	69·48	....	....	....	1,201·00	451·85	....
	3390, etc.	N.G.M., Ltd.	....	....	....	....	....	....	....	4,369·22	409·06	2·00
		Prior to transfer to present holders	....	....	....	....	....	....	....	2,675·00	459·60	....
	4229	Scorpio	....	....	378·00	35·56	....	....	....	378·00	35·56	....
	4068	Try Again	....	....	108·00	18·27	....	....	....	1,726·00	537·47	....
	4221	Two Bar	....	....	30·00	2·53	....	....	....	30·00	2·53	....
	4288	Two's and Three's	....	....	250·50	26·77	....	....	....	250·50	26·77	....
	4035	Undaunted	....	....	....	....	....	....	....	792·00	102·70	....
	4251	Union Jack	....	....	680·00	46·51	....	....	....	680·00	56·57	....
		Voided leases	....	....	....	....	....	....	1,494·77	640,740·26	186,563·43	2,466·10
		Sundry claims	....	....	291·50	54·36	....	11·35	230·20	34,727·36	13,098·83	·02
Mt. Jackson	(3418)	Clamps Central	....	....	....	17·32	....	....	....	927·00	674·27	....
	(3418)	(Mt. Jackson G.M's., N.L.)	....	....	....	....	....	....	....	8,456·50	7,122·98	6·34
		Voided leases	....	....	....	....	....	....	180·85	45,783·28	32,130·27	2,307·43
		Sundry claims	....	....	13·00	7·38	....	6·44	52·87	10,935·95	4,879·54	70·74
Mt. Palmer	(4285)	Speedie	....	....	520·00	36·26	....	....	....	520·00	36·26	....
		Voided leases	....	....	....	....	....	....	....	305,888·40	158,450·55	....
		Sundry claims	....	....	5·00	8·76	....	1,643·48	18·19	450·25	387·14	....
Mt. Rankin	3555	No Trumps	....	....	291·00	23·32	....	....	....	5,562·37	853·06	....
		Voided leases	....	....	....	....	....	3·84	5·20	496·00	122·17	....
		Sundry claims	....	....	....	....	....	....	....	491·00	117·59	....
Parker's Range	4191	Centipede	....	....	189·00	82·35	....	....	17·85	1,053·50	587·72	....
	4174	Constance Una	....	....	181·00	372·72	·06	....	....	639·50	1,557·56	·06
	(4276)	Two Bobs	....	....	66·00	4·00	....	....	....	66·00	4·00	....
	(4198)	Maroomba	....	....	26·00	10·10	....	....	99·57	312·00	175·92	....
	4201	Scot's Greys	....	....	85·00	18·15	....	....	....	486·00	96·16	....
	(4248)	Vance	....	....	42·00	4·78	....	....	....	50·00	10·59	....
		Voided leases	....	....	....	....	....	·42	149·33	59,683·35	29,539·61	26·40
		Sundry claims	....	2·57	352·00	97·54	....	6·59	303·93	11,570·80	5,082·33	·08
Southern Cross	4082	Day Dawn	....	....	....	....	....	....	....	86·00	9·16	....
	4018	Fraser's	....	....	17·00	2·37	....	....	....	1,376·50	164·49	....
	3944	Nil Desperandum	....	....	....	....	....	....	....	1,533·00	216·77	....
	3444, etc.	Western Mining Corporation	....	....	....	....	....	....	....	568·00	92·63	....
	3444, etc.	(Three Boys Gold Mines, Ltd.)	....	....	....	....	....	....	....	10,157·00	1,392·95	1·26
	3444	(Three Boys)	....	....	....	....	....	....	....	4,180·00	727·75	....
	3934	(Three Boys North)	....	....	....	....	....	....	....	106·00	14·66	....
	3981	(Three Kings)	....	....	....	....	....	....	....	104·00	10·01	....
	3444, etc.	(Yellowdine Options, N.L.)	....	....	....	....	....	....	....	8,074·25	2,000·29	....
		Voided leases	....	....	....	....	....	4·89	261·35	454,906·68	215,351·50	364·41
		Sundry claims	....	5·13	....	....	....	95·90	647·22	8,163·66	2,623·21	....
Westonia	4252	Corio	....	....	122·00	52·88	2·23	....	....	228·00	13·30	9·80
	4315	Edna May	....	....	60·00	14·83	....	....	....	60·00	14·83	....
	T.L. 132, M.L. 3	Edna May (W.A.) Amal. G.M., N.L.	....	....	....	....	....	....	....	145,417·00	62,905·87	5,072·49
		Prior to transfer to present holders	....	....	....	....	....	....	....	4,092·00	2,867·26	....
	4023	Greenfinch	....	....	....	....	....	....	....	640·15	478·46	....
		Voided leases	....	....	....	....	....	....	4·06	445,495·49	314,459·63	21·78
		Sundry claims	....	....	234·50	182·86	·02	9·51	64·96	4,155·66	2,713·79	·47

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons. (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons. (2,240 lb.).	Fine ozs.	Fine ozs.
YILGARN GOLDFIELD—continued.												
		From District generally :—										
		Sundry Parcels treated at :										
	M.A. 43	Butcher Bird Battery	....	....	....	....	....	....	....	....	*170·06	....
		Centenary Cyanide Plant	....	....	....	....	....	....	....	....	*472·85	....
		Copperhead Plant	....	....	....	....	....	....	....	....	*16,809·79	....
		Holleton Cyanide Plant	....	....	....	....	....	....	....	....	*699·68	48·05
		State Battery, Marvel Loch	....	....	....	*14·74	....	....	....	....	*14·74	....
		Howletts Battery	....	....	....	....	....	....	....	110·00	*13,405·34	....
		Invermay Battery	....	....	....	....	....	....	....	....	*608·49	3·57
		Kurrajong Battery	....	....	....	....	....	....	....	....	*409·57	....
		Pilot Cyanide Plant	....	....	....	....	....	....	....	30·00	*3,753·59	....
		Queen Ann Battery	....	....	....	....	....	....	....	....	*169·05	....
		Radio Deeps Cyanide Plant	....	....	....	....	....	....	....	....	*1,588·67	....
		Scot's Greys Cyanide Plant	....	....	....	*151·52	....	....	....	....	*320·90	....
		Three Boys' Cyanide Plant	....	....	....	*224·20	....	....	....	7·00	*3,088·38	....
		Wesley's Cyanide Plant	....	....	....	....	....	....	....	....	*1,251·05	....
		L.T.T. 1170H B. Perani's Plant,	....	....	38·00	*28·25	....	....	....	38·00	*28·25	....
		Various Works	....	....	....	....	....	....	....	181·28	*62,756·69	53·78
		Reported by Banks and Gold Dealers	....	....	....	....	....	314·38	70·45	....	30·85	....
		Totals	....	7·70	41,648·00	7,212·44	117·45	2,182·71	4,536·73	3,794,650·45	1,700,620·30	40,031·87
Dundas Goldfield.												
Buldania		Voided leases	....	....	....	....	....	....	3·02	846·05	708·99	....
		Sundry claims	....	....	....	....	....	....	39·25	1,324·27	861·36	·72
Dundas		Voided leases	....	....	....	....	....	1·88	28·02	6,103·48	2,545·38	155·02
		Sundry claims	....	....	....	....	....	·76	413·85	2,071·75	1,097·94	18·32
Norseman	1596	Abbotshall	....	....	....	....	....	....	....	2,511·45	1,096·71	754·37
	1468	Bronzewing	....	....	440·00	176·49	6·35	....	33·89	4,013·25	2,515·44	153·18
	1422, 1468	(Onkaparinga Leases)	....	....	....	....	....	....	....	698·00	831·67	3·62
	1617	Caesar	....	....	....	....	....	....	....	54·00	42·72	....
	1288, etc.	Central Norseman Gold Corporation, N.L.	....	....	155,822·00	42,475·14	38,317·12	....	....	1,380,504·20	480,397·48	418,127·77
		Prior to transfer to present holders	....	....	....	....	....	....	1,663·32	69,819·83	47,892·08	16,508·85
	1421	Dundas Gold Mines, N.L.	....	....	315·50	152·06	70·54	....	....	6,544·25	3,557·41	885·72

	1421	(Empress Gold Mines, N.L.)	....	....	....	....	....	....	....	567·50	516·08	54·61
	1721	Hopetoun	....	....	159·00	19·43	....	....	....	159·00	19·43	....
	1718	Iron Duke	....	....	294·75	82·93	....	....	....	294·75	82·93	....
	1822	Maschu	....	....	63·00	12·61	·24	....	....	63·00	12·61	·24
	1835	Mount Barker	....	....	11·00	2·71	·22	....	....	11·00	2·71	·22
	1719	Mt. Benson	....	....	11·50	2·94	....	....	....	11·50	2·94	....
	1315, etc.	Norseman Gold Mines, N.L.	....	....	....	....	....	....	....	964,099·00	240,900·95	353,206·54
		Prior to transfer to present holders	....	....	....	....	....	....	....	20,657·00	3,909·60	4,981·00
	1823	Sun	....	....	28·25	8·97	·52	....	....	28·25	8·97	·52
	1624	Valhalla	....	....	56·75	16·50	1·23	....	....	604·00	403·13	21·46
		Voided leases	....	....	....	....	....	14·27	10,567·26	897,707·97	591,701·35	37,099·04
		Sundry claims	....	....	963·75	182·99	5·88	1,052·09	3,393·11	46,834·70	22,087·93	199·09
Peninsular	1680	Hinemoa	....	....	18·50	1·88	....	....	....	18·50	1·88	....
		Voided leases	....	....	....	....	....	....	24·29	9,584·89	6,100·73	12·20
		Sundry claims	....	....	....	....	....	....	....	217·25	119·32	·97
	From District generally :—											
	Sundry Parcels treated at :—											
	State Battery, Norseman	....	....	12·50	486·82	·76	....	....	417·89	*25,113·92	1,051·13
	J. P. D. Parker's Plant, L.T.T. 1108H	....	....	....	....	....	....	....	12·00	3·80	·07
	Princess Royal Cyanide Plant, L.T.T. 1118H	....	....	....	23·58	8·82	....	....	....	*64·86	17·76
	(Princess Royal Cyanide Plant), L.T.T. 1022H	....	....	....	....	....	....	....	47·00	*123·29	106·89
	(Matson Cyanide Plant), L.T.T. 1022H	....	....	....	....	....	....	....	....	*53·80	40·79
	(Young and Prince Cyanide Plant), L.T.T. 1156H	....	....	....	....	....	....	....	....	*1,949·04	1,571·78
	Maitland and Miles Cyanide Plant, L.T.T. 1137H	....	....	23·00	1·74	·09	....	....	23·00	1·74	·09
	G. O. N. Parker's Plant, L.T.T. 1140H	....	....	44·50	4·11	....	....	....	44·50	4·11	....
	L. C. Petersen's Plant, L.T.T. 1150H	....	....	20·50	2·80	....	....	....	20·50	2·80	....
	Various Works	....	....	....	....	....	....	54·52	603·14	*12,880·21	844·36
	Reported by Banks and Gold Dealers	....	....	....	....	....	1,181·77	48·76	47·50	18·62	·70
	Totals	....	....	**158,284·50**	**43,653·70**	**38,411·77**	**2,250·77**	**16,269·29**	**3,416,564·37**	**1,447,633·93**	**835,817·03**

Phillips River Goldfield.

Hatters Hill	....	Voided leases	....	....	....	....	....	....	4·38	1,499·55	1,182·75	....
		Sundry claims	....	....	....	....	....	74·91	21·69	5,225·60	2,720·90	26·09
Kundip	263	Hillsborough	....	....	....	35·88	18·54	....	....	258·00	59·09	18·59
		Voided leases	....	....	....	....	....	113·28	556·17	84,866·58	60,584·54	4,008·81
		Sundry claims	....	....	....	....	....	90·27	73·02	6,434·68	1,951·87	54·65
Mt. Desmond	....	Voided leases	....	....	....	....	....	....	1·40	9·00	3,905·46	6,891·59
		Sundry claims	....	....	30·00	5·06	....	....	....	80·00	41·96	51·01
Ravensthorpe	....	Voided leases	....	....	....	....	....	....	141·80	24,723·55	26,070·94	4,384·07
		Sundry claims	....	....	....	....	....	163·96	7·68	7,261·57	3,195·67	41·12
West River	....	Voided leases	....	....	....	....	....	....	....	....	10·34	31·06
		Sundry claims	....	....	....	....	....	....	....	....	6·60	3·44

TABLE 1—*Production of Gold and Silver from all sources, etc.*—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1950.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
PHILLIPS RIVER GOLDFIELD—continued.												
		From Goldfield generally :—										
		Sundry Parcels treated at :—										
		Cordingup Copper Smelters, L.T.T. 1079H	....	....	....	*19·74	....	....	....	....	*41·79	7·24
		Cordingup Cyanide Plant	....	....	....	....	....	....	....	....	*909·37	4·36
		Floater Cyanide Works	....	....	....	....	....	....	....	12·00	*245·95	....
		Hatter's Hill Cyanide Plant	....	....	....	....	....	....	....	....	*342·19	....
		Kundip Cyanide Plant	....	....	....	....	....	....	....	15·00	15·25	....
		Various Works	....	....	....	....	....	....	....	....	*1,932·66	496·46
		Reported by Banks and Gold Dealers	....	....	....	4·76	....	164·69	12·14	....	4·76	....
		Totals	....	....	**30·00**	**65·44**	**18·54**	**607·11**	**818·28**	**130,385·53**	**103,222·09**	**16,018·49**
OUTSIDE PROCLAIMED GOLDFIELD.												
Burracoppin	....	Voided leases	....	....	....	....	....	....	....	710·85	706·38	....
		Sundry claims	....	·98	....	....	....	....	·98	372·75	213·97	....
Donnybrook	....	Voided leases	....	....	....	....	....	23·24	....	1,613·30	816·23	....
		Sundry claims	....	....	....	....	....	44·01	43·03	119·50	15·71	15·18
Jimperding	Avon 1P.P.	Hillsdale	....	....	....	9·95	....	....	....	1,261·75	308·00	....
Northampton	....	Sundry leases and claims	....	....	....	....	85·97	....	....	....	....	912·43
Ongerup	G.M.L. 98H	Calyerup Creek Gold Prospecting Co. Pty., Ltd.	....	....	9·75	4·10	....	....	....	9·75	4·10	....
		Sundry claims	....	1·58	·33	1·74	....	....	1·58	·33	1·74	....
		From State generally :—										
		Fremantle Smelters, Ltd.	....	....	....	....	....	....	....	....	1,879·08	1,109·06
		Miscellaneous voided leases and sundry claims	....	....	....	....	....	245·83	3·07	200·60	41·09	....
		Sundry specimens	....	....	....	....	....	4·24	56·85	....	....	....
		Various Works	....	....	....	....	....	....	....	27·00	7,130·67	30,412·67
		Reported by Banks and Gold Dealers	6·48	....	....	....	....	1,089·83	874·27	....	294·38	59·99
		Totals	**6·48**	**2·56**	**10·08**	**15·79**	**85·97**	**1,407·15**	**979·78**	**4,315·83**	**11,411·35**	**32,509·33**

TABLE II.

Production of Gold and Silver from all Sources, showing in fine ounces the output, as reported to the Mines Department during the year 1950.

Goldfield.	District.	District.						Goldfield.					
		Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Total Gold.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Total Gold.	Silver.
		Fine ozs.	Fine ozs.	Tons (2,240 lb.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.
Kimberley	....	....	....	....	....	....	....	118·34	1,122·88	....	....	1,241·22	....
West Kimberley	....	....	....	....	....	....	....	....	....	....	....	....	48·15
Pilbara	Marble Bar	77·73	....	7,980·75	3,818·28	3,896·01	4,303·52	246·11	98·80	9,735·25	5,063·37	5,408·28	4,306·14
	Nullagine	168·38	98·80	1,754·50	1,245·09	1,512·27	2·62						
West Pilbara	....	....	....	....	....	....	....	....	....	177·00	115·16	115·16	25·52
Ashburton	....	....	....	....	....	....	....	....	....	152·50	53·62	53·62	2,571·62
Gascoyne	....	....	....	....	....	....	....	....	....	....	....	....	....
Peak Hill	....	....	....	....	....	....	....	....	....	1,723·50	564·45	564·45	....
East Murchison	Lawlers	5·51	....	746·00	340·02	345·53	7·30	5·51	·92	4,496·50	3,060·50	3,066·93	203·80
	Wiluna	....	....	2,780·50	2,011·52	2,011·52	196·50						
	Black Range	....	·92	970·00	708·96	709·88	....						
Murchison	Cue	24·68	145·01	361,901·00	49,614·88	49,784·57	14,231·19	59·96	200·85	416,063·65	68,797·59	69,058·40	14,581·03
	Meekatharra	....	15·26	6,434·90	4,886·28	4,901·54	....						
	Day Dawn	16·18	12·20	2,207·75	2,490·41	2,518·79	80·17						
	Mt. Magnet	19·10	28·38	45,520·00	11,806·02	11,853·50	269·67						
Yalgoo	....	....	....	....	....	....	....	2·71	....	1,114·50	730·53	733·24	·10
Mt. Margaret	Mt. Morgans	18·97	3·34	1,438·25	1,521·19	1,543·50	....	32·10	9·45	97,620·25	32,633·66	32,675·21	3,297·61
	Mt. Malcolm	5·14	6·11	89,327·50	26,215·72	26,226·97	2,027·20						
	Mt. Margaret	7·99	....	6,854·50	4,896·75	4,904·74	1,270·41						
North Coolgardie	Menzies	1·98	....	12,458·75	6,540·92	6,542·90	505·75	2·21	....	18,651·00	11,886·49	11,888·70	687·12
	Ularring	....	....	3,140·00	2,749·49	2,749·49	....						
	Niagara	....	....	811·25	698·92	698·92	....						
	Yerrilla	·23	....	2,241·00	1,897·16	1,897·39	181·37						
Borad Arrow	....	....	....	....	....	....	....	7·25	74·32	3,592·20	3,294·30	3,375·87	....
N.E. Coolgardie	Kanowna	4·97	1·07	922·32	379·89	385·93	....	5·14	2·81	971·57	398·15	406·10	....
	Kurnalpi	·17	1·74	49·25	18·26	20·17	....						
East Coolgardie	East Coolgardie	56·56	24·76	1,661,173·97	407,838·22	407,919·54	99,954·71	73·76	26·37	1,662,146·97	408,068·66	408,168·79	99,954·71
	Bulong	17·20	1·61	973·00	230·44	249·25	....						
Coolgardie	Coolgardie	36·64	120·65	46,092·65	20,510·87	20,668·16	2,291·91	39·80	127·81	47,005·20	20,745·67	20,913·28	2,291·91
	Kunanalling	3·16	7·16	912·55	234·80	245·12	....						
Yilgarn	....	....	....	....	....	....	....	....	7·70	41,648·00	7,212·44	7,220·14	117·45
Dundas	....	....	....	....	....	....	....	....	....	158,284·50	43,653·70	43,653·70	38,411·77
Phillips River	....	....	....	....	....	....	....	....	....	30·00	65·44	65·44	18·54
Outside Proclaimed Goldfields	....	....	....	....	....	....	....	6·48	2·56	10·08	15·79	24·83	85·97
		....	....	....	....	....	....	599·37	1,674·47	2,463,422·67	606,359·52	608,633·36	166,601·44

TABLE III.

Return showing total production reported to the Mines Department, and respective Districts and Goldfields from whence derived, to 31st December, 1950.

Goldfield.	District.	District.						Goldfield.					
		Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Total Gold.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Total Gold.	Silver.
		Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.
Kimberley	....	....	....	....	....	....	....	8,629·05	2,030·62	22,589·40	17,118·56	27,778·23	113·68
West Kimberley	....	....	....	....	....	....	....	1·30	24·68	1·00	2·49	28·47	5,002·02
Pilbara	Marble Bar	15,062·67	4,428·90	309,379·37	307,456·59	326,948·16	7,148·26	25,174·81	6,310·37	412,633·95	415,138·11	446,623·29	7,254·81
	Nullagine	10,112·14	1,881·47	103,254·58	107,681·52	119,675·13	106·55						
West Pilbara	....	....	....	....	....	....	....	6,312·90	355·92	24,635·96	24,179·78	30,848·60	1,458·91
Ashburton	....	....	....	....	....	....	....	9,261·27	479·40	6,678·75	2,703·40	12,444·07	19,007·51
Gascoyne	....	....	....	....	....	....	....	693·44	41·57	387·00	517·29	1,252·30	....
Peak Hill	....	....	....	....	....	....	....	3,374·41	5,300·33	622,244·43	296,485·91	305,160·65	2,361·42
East Murchison	Lawlers	6,896·74	2,295·10	2,010,157·92	821,997·74	831·189·58	26,290·12	8,754·21	22,064·27	12,611,325·83	3,644,014·05	3,674,832·53	59,065·53
	Wiluna	222·36	1,247·37	8,873,029·94	1,870,370·74	1,871,840·47	10,281·34						
	Black Range	1,635·11	18,521·80	1,728,137·97	951,645·57	971,802·48	22,494·07						
Murchison	Cue	5,048·97	8,418·87	5,205,655·24	1,170,661·98	1,184,129·82	198,847·74	25,099·94	57,836·91	11,123,787·23	4,556,156·68	4,639,093·53	377,016·63
	Meekatharra	14,292·92	17,645·17	2,261,138·21	1,293,178·40	1,325,115·49	5,042·31						
	Day Dawn	3,200·56	11,339·12	2,028,140·38	1,371,882·14	1,386,421·82	169,310·57						
	Mt. Magnet	2,557·49	20,433·75	1,628,607·40	720,434·16	743,425·40	3,816·01						
Yalgoo	....	....	....	....	....	....	....	1,785·21	3,181·62	438,236·68	261,033·08	265,999·91	1,500·18
Mt. Margaret	Mt. Morgans	3,403·99	9,343·72	1,209,368·71	714,246·87	726,994·58	5,781·64	11,204·02	33,153·35	9,880,817·29	4,570,110·57	4,614,467·94	228,634·68
	Mt. Malcolm	3,806·10	14,489·65	6,180,618·19	2,698,397·30	2,716,693·05	158,726·25						
	Mt. Margaret	3,993·93	9,319·98	2,490,830·39	1,157,466·40	1,170,780·31	64,126·79						
North Coolgardie	Menzies	1,633·16	6,513·66	1,476,249·44	1,192,084·89	1,200,231·71	30,965·57	4,787·12	18,844·08	3,043,294·34	2,211,294·41	2,234,925·61	43,823·71
	Ularring	129·39	6,738·48	379,507·35	354,046·91	360,914·78	6,109·07						
	Niagara	1,712·66	1,819·15	928,699·77	515,957·54	519,489·35	5,603·60						
	Yerilla	1,311·91	3,772·79	258,837·78	149,205·07	154,289·77	1,145·47						
Broad Arrow	....	....	....	....	....	....	....	21,943·08	27,037·78	1,306,601·55	714,878·84	763,859·70	5,278·66
N.E. Coolgardie	Kanowna	106,497·74	13,509·60	1,001,073·51	623,995·32	744,002·66	3,039·73	119,331·77	21,808·51	1,014,421·58	642,501·58	783,641·86	3,205·44
	Kurnalpi	12,834·03	8,298·91	13,348·07	18,506·26	39,639·20	12·71						
East Coolgardie	East Coolgardie	33,527·96	40,756·90	58,497,725·99	28,991,048·83	29,065,333·69	4,069,983·11	60,923·57	56,786·10	58,680,763·29	29,122,394·69	29,240,104·36	4,069,996·03
	Bulong	27,395·61	16,029·20	183,037·30	131,345·86	174,770·67	12·92						
Coolgardie	Coolgardie	16,867·43	16,016·17	2,535,887·92	1,311,738·59	1,344,622·19	9,597·93	18,363·10	21,646·76	2,896,004·12	1,563,440·03	1,603,449·89	10,349·32
	Kunanalling	1,495·67	5,360·59	360,116·20	251,701·44	258,827·70	751·39						
Yilgarn	....	....	....	....	....	....	....	2,182·71	4,536·73	3,794,650·45	1,700,620·30	1,707,339·74	40,031·87
Dundas	....	....	....	....	....	....	....	2,250·77	16,269·29	3,416,564·37	1,447,633·93	1,466,153·99	835,817·03
Phillips River	....	....	....	....	....	....	....	607·11	818·28	130,385·53	103,222·09	104,647·48	16,018·49
Outside Proclaimed Goldfields		....	....	....	....	....	....	1,407·15	979·78	4,315·83	11,411·35	13,798·28	32,509·33
		....	....	....	....	....	....	332,086·94	299,506·35	109,430,338·58	51,304,857·14	51,936,450·43	5,758,292·25

TABLE IV.

Total output of Gold (Bullion and Concentrates entered for Export and Gold received at the Royal Mint, Perth), from 1st January, 1886, to 31st December, 1950; showing in Fine Ounces the quantity credited to the respective Goldfields.

Year.	Export.	Mint.	Total.	Export.	Mint.	Total.
		KIMBERLEY.			PILBARA.	
	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
Prior to 1947	22,422·06	13,787·52	36,209·58	150,518·94	343,889·15	494,408·09
1947	....	350·75	350·75	2,645·68	7,733·88	10,379·56
1948	....	438·32	438·32	1,864·05	4,630·05	6,494·10
1949	....	272·06	272·06	1,766·22	4,113·43	5,879·65
1950	....	1,135·94	1,135·94	1,107·45	4,341·93	5,449·38
Total	22,422·06	15,984·59	38,406·65	157,902·34	364,708·44	522,610·78
	(*a*) WEST PILBARA.				ASHBURTON.	
Prior to 1947	4,351·11	26,760·61	31,111·72	4,104·96	5,969·30	10,074·26
1947	....	....	....	....	150·76	150·76
1948	....	....	....	....	11·00	11·00
1949	....	....	....	....	60·46	60·46
1950	....	108·72	108·72	....	56·19	56·19
Total	4,351·11	26,869·33	31,220·44	4,104·96	6,247·71	10,352·67
	(*b*) Gascoyne.				(*c*) Peak Hill	
Prior to 1947	304·55	1,068·17	1,372·72	41,102·76	204,387·98	245,490·74
1947	....	....	....	....	1,086·25	1,086·25
1948	....	....	....	....	847·41	847·41
1949	....	....	....	....	285·80	285·80
1950	....	....	....	....	398·30	398·30
Total	304·55	1,068·17	1,372·72	41,102·76	207,005·74	248,108·50
	EAST MURCHISON.				MURCHISON.	
Prior to 1947	258,962·91	2,972,260·85	3,231,223·76	1,573,963·40	2,990,048·90	4,564,012·30
1947	70·79	22,591·28	22,662·07	125·56	89,592·05	89,717·61
1948	5·33	16,546·16	16,551·49	726·92	99,099·78	99,826·70
1949	31·91	7,185·88	7,217·79	366·15	85,443·83	85,809·98
1950	110·76	2,783·23	2,893·99	432·27	70,800·19	71,232·46
Total	259,181·70	3,021,367·40	3,280,549·10	1,575,614·30	3,334,984·75	4,910,599·05
	(*d*) YALGOO.			(*e*)	MT. MARGARET.	
Prior to 1947	13,594·12	191,589·08	205,183·20	693,137·60	3,658,968·12	4,352,105·72
1947	24·08	1,117·24	1,141·32	222·01	28,525·15	28,747·16
1948	17·77	1,177·31	1,195·08	683·02	22,691·66	23,374·68
1949	....	682·09	682·09	297·27	28,609·32	28,906·59
1950	14·59	695·23	709·82	88·86	29,535·88	29,624·74
Total	13,650·56	195,260·95	208,911·51	694,428·76	3,768,330·13	4,462,758·89
	(*f*) NORTH COOLGARDIE.			(*g*) BROAD ARROW.		
Prior to 1947	263,280·81	1,990,386·13	2,253,666·94	122,467·17	414,649·00	537,116·17
1947	18·31	6,744·87	6,763·18	79·39	7,704·06	7,783·45
1948	62·57	5,104·50	5,167·07	24·26	3,569·00	3,593·26
1949	48·29	5,098·20	5,146·49	47·87	4,015·49	4,063·36
1950	7·21	5,274·48	5,281·69	7·26	3,384·17	3,391·43
Total	263,417·19	2,012,608·18	2,276,025·37	122,625·95	433,321·72	555,947·67
	(*f*) NORTH-EAST COOLGARDIE.			(*f*) EAST COOLGARDIE.		
Prior to 1947	235,888·01	457,282·88	693,170·89	7,023,477·09	22,029,345·87	29,052,822·96
1947	....	827·76	827·76	1,253·91	462,611·28	463,865·19
1948	4·18	386·07	390·25	709·52	448,958·23	449,667·75
1949	1·50	96·02	97·52	792·52	445,291·23	446,083·75
1950	....	138·50	138·50	1,729·80	422,738·26	424,468·06
Total	235,893·69	458,731·23	694,624·92	7,027,962·84	23,808,944·87	30,836,907·71
	(*h*) COOLGARDIE.				YILGARN.	
Prior to 1947	662,956·59	1,184,407·08	1,847,363·67	219,378·24	1,496,942·09	1,716,320·33
1947	20·98	13,620·32	13,641·30	259·88	19,909·27	20,169·15
1948	54·14	8,070·99	8,125·13	268·15	10,529·09	10,797·24
1949	118·73	13,355·55	13,474·28	172·67	6,563·75	6,736·42
1950	44·24	18,024·30	18,068·54	59·14	6,724·00	6,783·14
Total	663,194·68	1,237,478·24	1,900,672·92	220,138·08	1,540,668·20	1,760,806·28
	(*i*) DUNDAS.			(*j*) PHILLIPS RIVER.		
Prior to 1947	169,785·49	1,230,316·51	1,400,102·00	40,606·91	62,649·03	103,255·94
1947	204·09	35,441·76	35,645·85	....	29·13	29·13
1948	65·92	37,609·08	37,675·00	....	28·44	28·44
1949	257·69	42,540·32	42,798·01	3·21	34·56	37·77
1950	410·04	39,171·22	39,581·26	37·59	51·85	89·44
Total	170,723·23	1,385,078·89	1,555,802·12	40,647·71	62,793·01	103,440·72
	¶ DONNYBROOK.			OUTSIDE PROCLAIMED FIELDS.		
Prior to 1947	282·21	557·53	839·74	21,879·52	37,080·86	58,960·38
1947	....	....	....	295·41	630·48	925·89
1948	....	....	....	167·89	634·98	802·87
1949	....	....	....	269·11	604·49	873·60
1950	....	....	....	112·32	809·49	921·81
Total	282·21	557·53	839·74	22,724·25	39,760·30	62,484·55

(*a*) Prior to 1st May, 1898, included with Pilbara, and from 12th July, 1929 to 15th September, included in Outside Proclaimed Goldfields. (*b*) Prior to March, 1899, included with Ashburton. (*c*) From 1st August, 1897. (*d*) Prior to 1st April, 1897, included with Murchison. (*e*) From 1st August, 1897. (*f*) Prior to 1st May, 1896, included with Coolgardie. (*g*) From 1st September, 1897. (*h*) Declared 5th April, 1894, to which date included with Yilgarn. (*i*) Prior to 1893, included with Yilgarn. (*j*) Prior to 1902, included in Outside Proclaimed Goldfields. ¶ Abolished 4th March, 1908.

TABLE V.

Total Output of Gold Bullion, Concentrates, etc., entered for Export and Received at the Perth Branch of the Royal Mint.

FROM 1st JANUARY, 1886.

Year.	Export.	Mint.	Total.	Estimated Value.
	Fine ozs.	Fine ozs.	Fine ozs.	£A.
1886	270·17	....	270·17	1,147
1887	4,359·37	....	4,359·37	18,518
1888	3,124·82	....	3,124·82	13,273
1889	13,859·52	....	13,859·52	58,871
1890	20,402·42	....	20,402·42	86,664
1891	27,116·14	....	27,116·14	115,182
1892	53,271·65	....	53,271·65	226,284
1893	99,202·50	....	99,202·50	421,385
1894	185,298·73	....	185,298·73	787,099
1895	207,110·20	....	207,110·20	879,749
1896	251,618·69	....	251,618·69	1,068,808
1897	603,846·44	....	603,846·44	2,564,977
1898	939,489·49	....	939,489·49	3,990,697
1899	1,283,360·25	187,244·41	1,470,604·66	6,246,732
1900	894,387·27	519,923·59	1,414,310·86	6,007,610
1901	923,698·96	779,729·56	1,703,416·52	7,235,654
1902	707,039·75	1,163,997·60	1,871,037·35	7,947,661
1903	833,685·78	1,231,115·62	2,064,801·40	8,770,719
1904	810,616·04	1,172,614·03	1,983,230·07	8,424,226
1905	655,098·88	1,300,226·00	1,955,315·88	8,305,654
1906	562,250·59	1,232,296·01	1,794,546·60	7,622,749
1907	431,803·14	1,265,750·45	1,697,553·59	7,210,750
1908	356,353·96	1,291,557·17	1,647,911·13	6,999,881
1909	386,370·58	1,208,898·83	1,595,269·41	6,776,274
1910	233,970·34	1,236,661·68	1,470,632·02	6,246,848
1911	160,422·28	1,210,445·24	1,370,867·52	5,823,075
1912	83,577·12	1,199,080·87	1,282,657·99	5,448,385
1913	86,255·13	1,227,788·15	1,314,043·28	5,581,701
1914	51,454·65	1,181,522·17	1,232,976·82	5,237,352
1915	17,340·47	1,192,771·23	1,210,111·70	5,140,228
1916	26,742·17	1,034,655·87	1,061,398·04	4,508,532
1917	9,022·49	961,294·67	970,317·16	4,121,646
1918	15,644·12	860,867·03	876,511·15	3,723,183
1919	6,445·89	727,619·90	734,065·79	3,618,509
1920	5,621·13	612,581·00	617,842·13	3,598,931
1921	7,170·74	546,559·92	553,730·66	2,942,526
1922	5,320·16	532,926·12	538,246·28	2,525,812
1923	5,933·82	498,577·59	504,511·41	2,232,186
1924	2,585·20	482,449·78	485,034·98	2,255,927
1925	3,910·59	437,341·56	441,252·15	1,874,320
1926	3,188·22	434,154·98	437,343·20	1,857,715
1927	3,359·10	404,993·41	408,352·51	1,734·572
1928	3,339·30	390,069·19	393,408·49	1,671,093
1929	3,037·12	374,138·96	377,176·08	1,602,142
1930	1,753·09	415,765·00	417,518·09	1,864,442
1931	1,726·66	508,845·36	510,572·02	2,998,137
1932	3,887·07	601,674·33	605,561·40	4,403,642
1933	2,446·97	634,760·40	637,207·37	4,886,254
1934	3,520·40	647,817·95	651,338·35	5,558,873
1935	9,868·71	639,180·38	649,049·09	5,702,149
1936	55,024·58	791,183·21	846,207·79	7,373,539
1937	71,646·91	928,999·84	1,000,646·75	8,743,755
1938	113,620·06	1,054,171·13	1,167,791·19	10,363,023
1939	98,739·88	1,115,497·76	1,214,237·64	11,842,964
1940	71,680·47	1,119,801·08	1,191,481·55	12,696,503
1941	65,925·94	1,043,391·96	1,109,317·90	11,851,445
1942	15,676·48	832,503·97	848,180·45	8,865,495
1943	6,408·34	540,057·08	546,475·42	5,710,669
1944	1,824·99	464,439·76	466,264·75	4,899,997
1945	5,029·38	463,521·34	468,550·72	5,010,541
1946	6,090·14	610,873·52	616,963·66	6,640,069
1947	5,220·09	698,666·29	703,886·38	7,575,574
1948	4,653·72	660,332·07	664,985·79	7,156,909
1949	4,173·14	644,252·48	648,425·62	7,962,808
1950	4,161·53	606,171·88	610,333·41	9,466,270
Total	11,540,672·93	41,921,769·38	53,462,442·31	315,098,305

	1949. £A.	1950. £A.
Estimated total par value of above production	224,501,434	227,093,964
Premiums received on sales of gold during 1920–1924 and 1930–1950 (approximate)	81,130,601	88,004,341
Estimated Total	£A305,632,035	£A315,098,305
Gross estimated value of gold won (including £161,448, bonus paid under the Commonwealth Bounty Act, 1930)	£A305,793,483	£A315,259,753

TABLE VI.—MINERALS OTHER THAN GOLD.

General Return of Ore and Minerals, other than Gold, showing the quantity produced and the value thereof as reported to the Mines Department from the respective Goldfields and Mineral Fields, during 1950, and previous years.

Period.	Abrasive Silica Stone.		Alunite (Crude Potash).		Arsenic.†		Antimony.*		
	Murchison Goldfield. (Mt. Magnet District).		Yilgarn Goldfield.		East Murchison Goldfield. (Wiluna District).		East Murchison Goldfield.		
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Conc.	Metal.	Value.
	tons.	£	tons.	£	tons.	£	tons.	tons.	£
Prior to 1947	....	....	4,037·80	79,984	37,236·20	712,991	7,883·66	3,870·93	157,298
1947	....	....	1,724·70	41,212	§1,191·13	28,738	....	....	....
1948	....	....	1,778·30	49,430	214·00	4,494	....	....	....
1949	1·50	9	1,447·80	43,417	32·75	982	....	....	....
1950	....	....	84·45	1,822	....	....	....	....	....
Total	1·50	9	9,073·05	215,865	38,674·08	747,205	7,883·66	3,870·93	157,208

* By-product of Gold Mining. † By-product by Wiluna G.Ms., Ltd. § Includes 1·13 tons Arsenic valued at £24 from Yilgarn Goldfield.

Period.	Antimony*—*continued.*						Asbestos.	
	Pilbara Goldfield.			Total.			Ashburton Goldfield.	
	Conc.	Metal.	Value.	Conc.	Metal.	Value.	Quantity.	Value.
	tons.	tons.	£	tons.	tons.	£	tons.	£
Prior to 1947	459·22	186·90	10,835	†8,363·66	4,069·39	168,624	10·10	959
1947	281·78	117·82	9,622	§287·23	119·82	9,731	....	....
1948	114·16	41·90	3,582	114·16	41·90	3,582	....	....
1949	21·68	9·49	954	21·68	9·49	954	....	....
1950	92·19	40·25	3,514	92·19	40·25	3,514	....	....
Total	969·03	396·36	28,507	8,878·92	4,280·85	186,405	10·10	959

* By-product of Gold Mining. † Includes 20·78 tons conc. containing 11·56 tons Metal valued at £491 from West Pilbara Goldfield. § Includes 5·45 tons conc. containing 2·00 tons Metal valued at £109 from West Pilbara Goldfield.

Period.	Asbestos—*continued.*							
	Pilbara Goldfield.		West Pilbara Goldfield.		Outside Proclaimed. Goldfield.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	1,226·91	56,006	3,712·90	135,785	141·86	1,571	*5,100·02	194,363
1947	·50	7	967·56	36,398	75·00	988	1,043·06	37,393
1948	....	....	678·61	33,588	284·24	4,173	962·85	37,761
1949	....	....	1,297·14	125,332	....	....	1,297·14	125,332
1950	....	....	1,230·15	152,677	....	....	1,230·15	152,677
Total	1,227·41	56,013	7,886·36	483,780	501·10	6,732	9,633·22	546,526

* Includes 4·75 tons valued at £20 from East Coolgardie Goldfield. † Includes 3·50 tons valued at £21 from East Coolgardie Goldfield.

Period.	Barytes.		Bentonite.		Beryl Ore.			
	North-East Coolgardie Goldfield.		Outside Proclaimed Goldfield.		Pilbara Goldfield.		Murchison Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	10·00	50	709·63	1,752	802·26	23,845	24·53	928
1947	....	....	44·75	134	16·04	513	....	....
1948	....	....	268·75	806	30·17	1,767	....	....
1949	....	....	150·00	450	....	....	....	....
1950	*16·00	56	213·00	599	4·74	442	....	....
Total	26·00	106	1,386·13	3,741	853·21	26,567	24·53	928

* From Outside Proclaimed Goldfields.

Table VI.—*Minerals other than Gold*—continued.

Period.	Beryl Ore—continued.							
	Coolgardie Goldfield.		West Kimberley Goldfield.		Outside Proclaimed Goldfield.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	47·94	1,465	....	....	86·37	2,544	961·10	28,782
1947	28·85	1,012	....	....	....	....	44·89	1,525
1948	4·68	267	....	....	....	....	34·85	2,034
1949	....	....	3·50	297	16·95	1,200	20·45	1,497
1950	....	....	....	....	12·19	989	16·93	1,431
Total	**81·47**	**2,744**	**3·50**	**297**	**115·51**	**4,733**	**1,078·22**	**35,269**

Period.	Bismuth.		Clays (Cement, Pottery and Fireclay).					
	Outside Proclaimed Goldfield.		Collie Mineral Field.		Outside Proclaimed Goldfield.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	lb.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	5,506·40	1,800	1,050·80	738	11,444·75	5,807	12,495·55	6,545
1947	....	....	....	....	6,277·50	6,064	6,277·50	6,064
1948	....	....	....	....	4,858·50	4,113	4,858·50	4,113
1949	....	....	....	....	10,047·00	11,813	10,047·00	11,813
1950	....	....	....	....	6,439·00	4,936	6,439·00	4,936
Total	**5,506·40**	**1,800**	**1,050·80**	**738**	**39,066·75**	**32,733**	**40,117·55**	**33,471**

Period.	Coal.		Copper Ore.					
	Collie Coalfield.		West Kimberley Goldfield.		Pilbara Goldfield.			
					Marble Bar District.		Nullagine District.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	18,387,521·57	13,096,614	109·52	1,709	32·87	386	14·00	480
1947	730,506·32	840,249	....	....	....	....	....	....
1948	732,938·42	880,236	....	....	....	....	....	....
1949	750,594·06	972,245	....	....	....	....	....	....
1950	814,351·53	1,287,749	....	....	....	....	....	....
Total	**21,415,911·90**	**17,077,093**	**109·52**	**1,709**	**32·87**	**386**	**14·00**	**480**

Period.	Copper Ore—*continued.*							
	West Pilbara Goldfield.		Ashburton Goldfield.		Peak Hill Goldfield.		East Murchison Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	82,745·45	748,482	353·07	6,431	1,043·35	32,632	284·31	5,052
1947	....	....	....	....	....	....	....	....
1948	....	....	....	....	....	....	....	....
1949	....	....	1·30	13	8·19	498	....	....
1950	....	....	....	....	....	....	....	....
Total	**82,745·45**	**748,482**	**354·37**	**6,444**	**1,051·54**	**33,130**	**284·31**	**5,052**

Period.	Copper Ore—*continued.*							
	Murchison Goldfield.		Yalgoo Goldfield.		Northampton Mineral Field.		Yandanooka Mineral Field.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	1,042·02	11,290	82·35	811	24,026·25	119,497	171·55	1,889
1947	....	....	....	....	....	....	....	....
1948	....	....	....	....	....	....	....	....
1949	....	....	....	....	....	....	....	....
1950	....	....	....	....	....	....	....	....
Total	**1,041·02**	**11,290**	**82·35**	**811**	**24,026·25**	**119,497**	**171·55**	**1,889**

Table VI.—*Minerals other than Gold*—continued.

Period.	Copper Ore—*continued.*							
	Mt. Margaret Goldfield.		North Coolgardie Goldfield (Menzies District).		East Coolgardie Goldfield (East Coolgardie District).		Phillips River Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	47,860·52	230,846	6·12	51	50·67	379	95,831·64	589,040
1947	....	....	....	....	....	....	....	....
1948	....	....	....	....	....	....	....	....
1949	....	....	....	....	....	....	40·00	119
1950	....	*107	....	....	....	....	48·00	76
Total	**47,860·52**	**230,953**	**6·12**	**51**	**50·67**	**379**	**95,919·64**	**589,235**

* 2·54 tons Copper Matte.

Period.	Copper Ore—*continued.*						Cupreous Ore (Fertiliser).	
	Yilgarn Goldfield.		Outside Proclaimed Goldfield.		Total.		West Pilbara Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
1947	16·00	77	5·11	56	253,674·80	1,749,108	....	....
1947	....	....	....	....	....	....	....	....
1948	....	....	....	....	....	....	....	....
1949	....	....	....	....	49·49	630	133·98	1,844
1950	....	....	....	....	48·00	183	821·40	6,160
Total	**16·00**	**77**	**6·11**	**56**	**253,772·29**	**1,749,921**	**955·38**	**8,004**

Period.	Cupreous Ore (Fertiliser)—*continued.*						Diamonds.	
	Peak Hill Goldfield.		Yalgoo Goldfield.		Total.		Pilbara Goldfield. (Nullagine District.)	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	carats.	£
Prior to 1947	....	....	....	....	....	....	....	24
1947	*917·00	6,071	....	....	*917·00	6,071	....	....
1948	258·65	2,204	....	....	258·65	2,204	....	....
1949	113·00	929	7·00	48	253·98	2,821	....	....
1950	93·90	2,304	....	....	†969·85	8,867	....	....
Total	**1,382·55**	**11,508**	**7·00**	**48**	**2,399·48**	**19,963**	....	**24**

* Includes 409 tons valued at £2,968 late reported for years 1944, 1945, 1946. † Includes 9·21 tons, valued at £64, 38·37 tons valued at £133 and 6·97 tons valued at £206 from Mt. Margaret, Yilgarn and Phillips River Goldfields respectively.

Period.	Diatomaceous Earth.		Dolomite.		Emeralds.		Emery.	
	Outside Proclaimed Goldfield.		Murchison Goldfield (Mt. Magnet District).		Murchison Goldfield (Cue District).		Outside Proclaimed Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	carats (cut and rough).	£	tons.	£
Prior to 1947	85·00	810	361·95	1,787	18,373·00	1,609	13·00	130
1947	5·00	50	56·85	285	....	....	....	....
1948	....	....	107·25	536	....	....	....	....
1949	540·00	950	49·50	247	....	....	....	....
1950	....	....	319·85	1,268	....	....	....	....
Total	**630·00**	**1,810**	**895·40**	**4,123**	**18,373·00**	**1,609**	**13·00**	**130**

Period.	Felspar.						Gadolinite.	
	Coolgardie Goldfield.		Outside Proclaimed Goldfield.		Total.		Pilbara Goldfield (Marble Bar District).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	35,298·30	87,371	528·00	1,050	35,826·30	88,421	1·00	112
1947	1,226·00	4,291	....	....	1,226·00	4,291	....	....
1948	1,011·00	3,538	....	....	1,011·00	3,538	....	....
1949	1,049·00	3,934	....	....	1,049·00	3,934	....	....
1950	1,421·00	5,329	....	....	1,421·00	5,329	....	....
Total	**40,005·30**	**104,463**	**528·00**	**1,050**	**40,533·30**	**105,513**	**1·00**	**112**

Table VI.—*Minerals other than Gold*—continued.

Period.	Glass Sand.		Glauconite.		Graphite.		Gypsum.	
	Outside Proclaimed Goldfield.		Outside Proclaimed Goldfield.		Outside Proclaimed Goldfield.		Dundas Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	1,016·05	1,161	3,196·00	43,883	18·10	97	1,613·00	668
1947	364·40	469	350·50	8,763	....	....	376·00	564
1948	516·90	644	319·00	7,975	....	....	....	....
1949	986·15	1,014	203·50	5,286	....	....	10·00	6
1950	5,132·25	3,566	323·50	8,735	....	....	....	....
Total	8,015·75	6,854	4,392·50	74,642	18·10	97	1,999·00	1,238

Period.	Gypsum—*continued.*						Ilmenite Sand.	
	Yilgarn Goldfield.		Outside Proclaimed Goldfield.		Total.		Outside Proclaimed Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	15,386·00	16,910	125,991·65	152,145	142,990·65	169,723	....	....
1947	8,953·50	13,430	10,952·00	14,780	20,281·50	28,774	....	....
1948	15,870·00	24,527	9,651·50	10,646	25,521·50	35,173	....	....
1949	15,962·00	11,181	9,935·30	7,423	25,907·30	18,610	71·95	255
1950	20,446·00	14,372	10,389·40	7,570	30,835·40	21,942	84·00	521
Total	76,617·50	80,420	166,919·85	192,564	245,536·35	274,222	155·95	776

Period.	Iron Ore.		Jarosite.		Kaolin.		Kyanite.	
	Outside Proclaimed Goldfield.		Phillips River Goldfield.		Outside Proclaimed Goldfield.		Outside Proclaimed Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	*58,064·35	37,048	....	....	3,433·48	3,625	159·69	668
1947	....	....	9·54	37	581·00	310	2,931·00	14,597
1948	7,222·20	26,165	....	....	146·00	292	1,125·00	6,516
1949	12,524·13	66,296	....	....	80·00	160	....	....
1950	14,895·23	82,682	....	....	....	....	....	....
Total	92,705·91	212,191	9·54	37	4,240·48	4,387	4,215·69	21,78

* Includes 450 tons valued at £247 from East Coolgardie Goldfield. Includes 100 tons valued at £300 from West Pilbara Goldfield. Includes 84·35 tons valued at £128 from Yilgarn Goldfield.

Period.	Calcite.		Lead Ore and Concentrates.					
	Mt. Margaret Goldfield.		Northampton Mineral Field.		Outside Proclaimed Goldfield.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	....	....	417,989·53	1,282,362	12·19	13	418,001·72	1,282,375
1947	....	....	5·89	326	....	....	5·89	326
1948	....	....	1,345·19	92,492	....	....	1,345·19	92,492
1949	....	....	1,834·87	100,899	....	....	1,834·87	100,899
1950	5·00	25	1,035·05	66,389	....	....	1,035·05	66,389
Total	5·00	25	422,210·53	1,542.468	12·19	13	422,222·72	1,542.481

Table VI.—*Minerals other than Gold*—continued.

Period.	Magnesite.							
	East Coolgardie Goldfield. (Bulong District).		Coolgardie Goldfield.		Outside Proclaimed Goldfield.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	935·25	1,167	291·65	342	....	....	1,226·90	1,509
1947	73·00	73	....	....	....	....	73·00	73
1948	....	....	466·75	1,691	495·07	1,485	961·82	3,176
1949	26·71	74	21·00	57	1,986·05	4,583	2,033·76	4,714
1950	....	....	40·00	175	1,788·70	3,650	1,828·70	3,825
Total	1,034·96	1,314	819·40	2,265	4,269·82	9,718	6,124·18	13,297

Period.	Manganese Ore.		Mica.		Ochre.			
	Peak Hill Goldfield.		Outside Proclaimed Goldfield.		West Pilbara Goldfield		Murchison Goldfield. (Cue District).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	lb.	£	tons.	£	tons.	£
Prior to 1947	76·74	436	†31,676·25	2,641	3,351·45	41,238	629·85	5,281
1947	....	....	....	....	191·20	2,635	823·40	8,123
1948	*1,644·85	10,442	....	....	185·00	2,682	381·37	4,109
1949	9,420·31	56,289	§1,253·75	1,343	15·60	225	7·55	38
1950	11,961·64	65,459	....	....	....	....	186·00	1,860
Total	23,103·54	132,626	32,930·00	3,984	3,743·25	46,780	2,028·17	19,411

* Includes 20 tons valued at £180 from Mt. Margaret Goldfield and 24·85 tons valued at £112 from Outside Proclaimed Goldfield. † Includes 7,868 lb. Crude Mica. § Includes 31·25 lb. Mica valued at £5 from West Kimberley Goldfield.

Period.	Ochre—*continued.*							
	Pilbara Goldfield.		Yalgoo Goldfield.		East Coolgardie Goldfield.		North-East Coolgardie Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	....	....	....	....	35·35	126	....	....
1947	2·10	15	....	....	....	....	10·40	88
1948	....	....	....	....	....	....	....	....
1949	....	....	11·00	66	10·00	37	....	....
1950	....	....	....	....	....	....	....	....
Total	2·10	15	11·00	66	45·35	163	10·40	88

Period.	Ochre—*continued.*		Petalite.		Phosphatic Guano.		Pyrites.	
	Total.		Coolgardie Goldfield.		Outside Proclaimed Goldfield.		Dundas Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	*4,052·65	46,753	....	....	10,799·73	59,174	†179,997·56	342,824
1947	1,027·10	10,856	....	....	....	....	44,337·00	187,621
1948	566·37	6,791	....	....	....	....	37,499·00	164,203
1949	44·15	366	5·19	52	....	....	31,299·00	125,857
1950	186·00	1,860	....	....	....	....	35,213·00	163,514
Total	5,876·27	66,626	5·19	52	10,799·73	59,174	332,345·56	984,019

* Includes 36 tons valued at £108 from Outside Proclaimed Goldfield. † Includes 74,047·56 tons valued at £45,496 from Mt. Margaret Goldfield.

Table VI.—*Minerals other than Gold*—continued.

Period.	Sillimanite.		Silver Lead Ore and Concentrates.					
	Outside Proclaimed Goldfield.		Kimberley Goldfield.		Pilbara Goldfield.		West Pilbara Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	....	....	....	....	195·35	3,658	106·57	1,529
1947	....	....	....	....	16·47	626	....	....
1948	2·00	13	4·07	196	....	....	2·07	62
1949	....	....	2·46	161	235·15	11,103	15·32	453
1950	....	....	....	....	445·22	21,859	2·24	75
Total	2·00	13	6·53	357	892·19	37,246	126·20	2,119

Period.	Silver Lead Ore and Concentrates—*continued.*						Silver Lead Zinc Ore and Concentrates.	
	Ashburton Goldfield.		Peak Hill Goldfield.		Total.		West Kimberley Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	2,973·78	87,905	....	....	3,275·70	43,092	....	....
1947	....	....	....	....	16·47	626	....	....
1948	126·76	6,969	....	....	132·90	7,227	713·46	13,599
1949	719·92	35,926	5·50	285	978·35	47,928	33·38	1,456
1950	345·62	21,743	....	....	793·08	43,677	7·83	206
Total	4,166·08	102,543	5·50	285	5,196·50	142,550	754·67	15,261

Period.	Silver Lead Zinc Ore and Concentrates—*contd.*				Soapstone.			
	Northampton Mineral Field.		Total.		Greenbushes Mineral Field.		Outside Proclaimed Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	....	....	....	....	517·00	1,778	10·00	25
1947	....	....	....	....	....	....	....	....
1948	....	....	713·46	13,599	....	....	....	....
1949	75·53	2,710	108·91	4,166	....	....	....	....
1950	29·83	1,376	37·66	1,582	....	....	....	....
Total	105·36	4,086	860·03	19,347	517·00	1,778	10·00	25

Period.	Soapstone—*continued.*		Talc.					
	Total.		East Coolgardie Goldfield.		Outside Proclaimed Goldfield.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	527·00	1,803	499·96	1,726	....	....	499·96	1,726
1947	....	....	213·00	813	....	....	213·00	813
1948	....	....	72·00	732	....	....	72·00	732
1949	....	....	....	....	181·00	2,375	181·00	2,375
1950	....	....	56·00	210	200·00	2,490	256·00	2,700
Total	527·00	1,803	840·96	3,481	381·00	4,865	1,221·96	8,346

Table VI.—*Minerals other than Gold*—continued.

Period.	Tantalite.							
	Pilbara Goldfield (Marble Bar District.)				Greenbushes Mineral Field.			
	Quantity.			Value.	Quantity.			Value.
	Lode.	Stream.	Total.		Lode.	Stream.	Total.	
	tons.	tons.	tons.	£	tons.	tons.	tons.	£
Prior to 1947	63·26	201·81	265·07	130,672	....	11·51	11·51	9,079
1947	....	....	....	....	....	....	....	....
1948	....	....	....	....	....	3·78	3·78	973
1949	....	....	....	....	....	....	....	....
1950	....	....	....	....	....	....	....	....
Total	63·26	201·81	265·07	130,672	....	15·29	15·29	10,052

Period.	Tantalite—*continued.*				Tin.			
	Total.				Pilbara Goldfield (Marble Bar District).			
	Quantity.			Value.	Quantity.			Value.
	Lode.	Stream.	Total.		Lode.	Stream.	Total.	
	tons.	tons.	tons.	£	tons.	tons.	tons.	£
Prior to 1947	*66·07	213·32	279·39	142,260	372·62	5,577·30	5,949·92	556,844
1947	....	....	....	....	....	17·90	17·90	4,109
1948	....	3·78	3·78	973	....	34·99	34·99	12,389
1949	....	....	....	....	....	31·52	31·52	11,980
1950	....	....	....	....	....	21·07	21·07	8,477
Total	66·07	217·10	283·17	143,233	372·62	5,682·78	6,055·40	593,799

* Includes 2·81 tons valued at £2,509 from Coolgardie Goldfield.

Period.	Tin—*continued.*							
	Greenbushes Mineral Field.				Total.			
	Quantity.			Value.	Quantity.			Value.
	Lode.	Stream.	Total.		Lode.	Stream.	Total.	
	tons.	tons.	tons.	£	tons.	tons.	tons.	£
Prior to 1947	350·96	11,021·08	11,372·04	1,005,586	†724·57	*16,603·85	17,328·42	1,563,097
1947	....	5·73	5·73	1,456	....	23·63	23·63	5,565
1948	....	2·00	2·00	596	....	36·99	36·99	12,985
1949	....	3·14	3·14	1,099	....	34·66	34·66	13,079
1950	....	30·34	30·34	17,019	....	51·41	51·41	25,496
Total	350·96	11,062·29	11,413·25	1,025,756	724·57	16,750·54	17,475·11	1,620,222

* Includes ·60 tons valued at £143, 4·72 tons valued at £300 and ·15 tons valued at £15 from Kimberley, Murchison and Coolgardie Goldfields respectively. † Includes ·60 tons valued at £46 and ·39 tons valued at £103 from Yilgarn and East Murchison Goldfields respectively.

Period.	Tantalo Columbite Ore and Concentrates.					
	Pilbara Goldfield.		Greenbushes Mineral Field.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£
Prior to 1947	....	....	....	....	....	....
1947	....	....	....	....	....	....
1948	·53	166	....	....	·53	166
1949	....	....	1·16	286	1·16	286
1950	2·29	749	4·41	2,109	6·70	2,858
Total	2·82	915	5·57	2,395	8·39	3,310

Table VI.—*Minerals other than Gold*—continued.

Period.	SCHEELITE							
	Murchison Goldfield.		Yalgoo Goldfield.		Broad Arrow Goldfield.		Coolgardie Goldfield.	
	Conc.	Value.	Conc.	Value.	Conc.	Value.	Conc.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	·16	59	2·99	1,050	1·01	175	19·87	4,693
1947	....	....	....	....	....	....	·47	130
1948	....	....	....	....	....	....	·41	196
1949	....	....	....	....	....	....	·58	219
1950	....	....	....	....	....	....	....	....
Total	·16	59	2·99	1,050	1·01	175	21·33	5,238

Period.	SCHEELITE—*continued.*							
	North Coolgardie Goldfield. (Menzies District).		Yilgarn Goldfield.		Dundas Goldfield.		Total.	
	Conc.	Value.	Conc.	Value.	Conc.	Value.	Conc.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	6·45	1,030	90·07	31,660	·08	19	120·63	38,686
1947	....	....	9·81	3,710	....	....	10·28	3,840
1948	....	....	6·86	3,717	....	....	7·27	3,913
1949	....	....	....	....	....	....	·58	219
1950	....	....	....	....	....	....	....	....
Total	6·45	1,030	106·74	39,087	·08	19	138·76	46,658

Period.	WOLFRAM.							
	West Kimberley Goldfield.		Murchison Goldfield. (Cue District).		Yalgoo Goldfield.		Broad Arrow Goldfield.	
	Ore and Conc.	Value	Ore and Conc.	Value.	Ore and Conc.	Value.	Ore and Conc.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	28·48	331	238·64	1,148	·72	115	·28	88
1947	....	....	....	....	....	....	....	....
1948	....	....	....	....	....	....	....	....
1949	....	....	....	....	....	....	....	....
1950	....	....	....	....	....	....	....	....
Total	28·48	331	238·64	1,148	·72	115	·28	88

Period.	WOLFRAM—*continued.*		VERMICULITE.					
	Total.		East Coolgardie Goldfield (Bulong District).		Outside Proclaimed Goldfield.		Total.	
	Ore and Conc.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1947	268·12	1,682	97·90	689	1,108·55	6,717	1,226·45	7,456
1947	....	....	....	....	82·00	492	82·00	492
1948	....	....	*5·00	*28	91·00	546	*96·00	*574
1949	....	....	23·22	155	138·75	832	161·97	987
1950	....	....	....	....	120·00	720	120·00	720
Total	268·12	1,682	126·12	872	1,540·30	9,307	1,686·42	10,289

* Adjusted figures. † Includes 20 tons valued at £60 from Yilgarn Goldfield.

TABLE VII.

Quantity and Value of Minerals, other than Gold and Silver, reported during year 1950.

Number of Lease, Claim, or Area.	Goldfield or Mineral Field.	Registered Name of Producer.	Quantity.	Metallic. Content.	Value.
		ALUNITE.			
			tons.	Crude Potash recovered.	£A.
M.L.'s 43, etc.	Yilgarn	State (W.A.) Alunite Industry	904·00	84·45	(c) 1,822·22
		ANTIMONY. (e) (g).			
			Ore and Concentrates tons.	Antimony. tons.	
G.M.L.'s 231L, etc.	Pilbara	Blue Spec G.M.'s, N.L.	88·66	38·53	3,317·78
P.A. 657L.	Pilbara	Roberts and Kinnunen	3·53	1·72	195·99
			92·19	40·25	(b) 3,513·77
		ASBESTOS (CHRYSOTILE).			
M.C.'s 48, 68	West Pilbara	Hancock, L. G.	210·74	....	9,156·56
		ASBESTOS (CROCIDOLITE).			
M.C.'s 54, etc.	West Pilbara....	Australian Blue Asbestos, Ltd.	1,018·41	....	143,495·83
		ASBESTOS (TREMOLITE).			
M.C.'s 48, 68	West Pilbara	Hancock, L. G.	1·00	....	25·00
			1,230·15	....	b 152,677·39
		BARYTES.			
P.A. 907H (Cranbrook)....	O.P.G.	Mitchell & Kleeman	16·00	....	(a) 56·00
		BENTONITE.			
M.C.'s 282H, 397H (Marchargee)	O.P.G.	Fennell, W. G.	163·00	....	524·00
P.A.'s 920H, etc. (Marchargee)	O.P.G.	Noonan & Hocking	50·00	....	75·00
			213·00	....	(a) 599·00
		BERYL (e) (g).			
				BeO Long Ton Units.	
P.A. 2337	Pilbara	Gilbert, J.	·99	12·16	92·85
Crown Lands	Pilbara	Lamont, G.	3·75	45·72	349·20
M.C.'s 414H, 415H (Yinnietharra)	O.P.G.	Western Rare Metals, Ltd.	7·26	74·05	576·22
P.A. 895H (Yinnietharra)	O.P.G.	Woodman, S. J.	4·93	54·23	413·00
			16·93	186·16	(b) 1,431·27
		CALCITE.			
P.A. 1610F	Mt. Margaret....	Campbell, J. S.	5·00	....	(a) 25·00
		CLAY (FIRECLAY).			
M.C.'s 380H, etc. (Clackline)	O.P.G.	Clackline Refractories, Ltd.	4,064·00	....	2,032·00
M.L. 53 PP (Bakers Hill)	O.P.G.	Dunn & Pedler	600·00	....	630·00
Private Property (Glen Forrest)	O.P.G.	Darling Range Firebrick Co. Pty., Ltd.	1,175·00	....	1,074·20
			5,839·00	....	3,736·20
		CLAY (POTTERY CLAY).			
M.C. 109H (Goomalling)	O.P.G.	H.L. Brisbane & Wunderlich, Ltd....	600·00	....	1,200·00
			6,439·00	....	(c) 4,936·20

Table VII.—*Minerals other than Gold*—continued.

Quantity and Value of Minerals, other than Gold and Silver, reported during year 1950.

Number of Lease, Claim or Area.	Goldfield or Mineral Field.	Registered Name of Producer.	Quantity.	Metallic Content.	Value.
		COAL.	tons.		£A.
M.L.'s 314, etc.	Collie	Griffin Coal Mining Co., Ltd.—			
		Griffin Mine	68,807·15	....	104,930·95
		Wyvern Mine	94,268·45	....	143,759·50
		Pheonix Mine	6,296·60	....	9,602·10
M.L.'s 250, etc.	Collie	Amalgamated Collieries of W.A., Ltd.—			
		Cardiff Mine	104,333·12	....	164,510·05
		Co-operative Mine	73,461·54	....	117,857·20
		Proprietary Mine	115,861·75	....	183,739·10
		Stockton Mine	93,012·88	....	148,552·55
		Stockton Open Cut	169,910·05	....	272,939·35
		Black Diamond Open Cut	83,449·99	....	134,000·10
Temp. Res. 1235H	Collie	Western Collieries, Ltd.—			
		Collie Burn Open Cut	4,950·00	....	7,858·00
			814,351·53	.... (*d*)	1,287,748·90
		COPPER FERILISER.	Ore and Concentrates. tons.	Average Assay. % Cu.	
Freehold Property	West Pilbara	Walters, I.	821·40	7·53	6,160·12
M.C. 34P	Peak Hill	White, A. F.	55·50	23·98	1,595·85
M.C. 37P	Peak Hill	Edwards & Hilditch	32·00	22·00	640·00
P.A. 817P	Peak Hill	Edwards, R. W.	6·40	10·62	68·00
P.A. 1613F	Mt. Margaret	Cable, D.	9·21	9·19	63·80
P.A. 6603	Yilgarn	Polkinghorne & Scurry	38·37	4·50	133·00
L.T.T. 1079H	Phillips River	Wehr Bros.	6·97	24·23	206·15
			969·85	8·98	(*a*)(*b*)8,866·92
		COPPER (*e*) (*g*).	Concentrates. tons.	Copper. tons.	
P.A. 1599F	Mt. Margaret	Philiphoff, A.	(*f*)	·84	107·40
L.T.T. 1079H	Phillips River	Wehr Bros.	2·50	·57	75·75
			2·50	1·41	(*b*) 183·15
		DOLOMITE.			
M.L.'s 10M, etc.	Murchison	Atkinson & Giles	319·85	....	(*a*) 1,268·25
		FELSPAR.			
M.L.'s 80, etc.	Coolgardie	Australian Glass Manufacturers Co. Pty., Ltd.	1,421·00	....	(*b*) 5,328·75
		GLASS SAND.			
M.C.'s 417H, 418H (Lake Gnangara)	O.P.G.	Australian Glass Manufacturers Co. Pty., Ltd.	4,565·85	....	2,739·51
M.C. 365H (East Wanneroo)	O.P.G.	Leach, R. J.	393·40	....	590·20
M.C.'s 161H, etc. (Lake Gnangara)	O.P.G.	Leach, W. M.	173·00	....	236·00
			5,132·25	....	(*c*) 3,565·71
		GLAUCONITE.	Greensand treated. tons.	Glauconite recovered. tons.	
Private Property (Gingin)	O.P.G.	Brook, G. E.	1,617·50	323·50	(*b*) 8,734·50
		GYPSUM.			
M.C.'s 30, etc.	Yilgarn	Ajax Plaster Co., Ltd.	5,562·00	....	4,257·40
M.C.'s 280H, etc. (Lake Brown)	O.P.G.	H. B. Brady Co. Pty., Ltd., and Saunders, G. R. (Jnr.)	4,645·50	....	3,484·10
M.C.'s 395H, etc. (Lake Brown)	O.P.G.	A. H. Jose & Co.	120·00	....	120·00
M.C.'s 31H, etc. (Baandee)	O.P.G.	Millars Timber & Trading Co.	713·00	....	839·50
M.C.'s 126H, etc. (Baandee)	O.P.G.	Perth Modelling Works, Ltd.	3,510·00	....	1,930·50
M.C.'s 9, etc.	Yilgarn	Perth Modelling Works, Ltd.	14,884·00	....	10,114·30
M.L. 52PP (Hines Hill)	O.P.G.	Feineler, K. J.	556·90	....	311·10
M.C. 293H (Woolundra)	O.P.G.	Ripper, P.	669·00	....	754·20
M.C. 440H (Hines Hill)	O.P.G.	Fitzgerald, E. J.	175·00	....	131·25
			30,835·40	....	(*a*)21,942·35

Plaster of Paris reported as manufactured during the year being 22,424·25 tons from 31·147·50 tons of Gypsum by five factories.

Table VII.—*Minerals other than Gold*—continued.

Quantity and Value of Minerals, other than Gold and Silver, reported during year 1950.

Number of Lease, Claim or Area.	Goldfield or Mineral Field.	Registered Name of Producer.	Quantity.	Metallic Content.	Value.
		ILMENITE RUTILE ZIRCON SAND.	tons.		£A.
D.C.'S 9H, etc. (Cheyne Bay)	O.P.G.	Rare Metals Pty., Ltd.	84·00	....	(*b*) 521·00
		IRON ORE.	Iron Ore. tons.	Pig Iron recovered. tons.	
Crown Lands (Wundowie)	O.P.G.	The Charcoal Iron and Steel Industry....	11,825·25	5,890·99	62,760·24
	Yilgarn	The Charcoal Iron and Steel Industry....	3,069·98	1,834·65	19,922·13
			14,895·23	7,725·64	(*c*) 82,682·37
		LEAD ORES AND CONCENTRATES. *See* foot of Table.			
		MAGNESITE.			
M.L.'s 87, etc.	Coolgardie	Scahill & Gibbons	40·00	....	175·00
Private Property (Northam)	O.P.G.	The Charcoal Iron and Steel Industry....	(*i*) 1,788·70	....	3,650·08
			1,828·70	....	(*a*)(*c*)3,825·08
		MANGANESE ORE.			
M.C.'s 28P, etc.	Peak Hill	The Broken Hill Pty. Co., Ltd.	5,050·75	....	22,858·33
M.C.'s 24P, etc.	Peak Hill	Westralian Ores Pty., Ltd.	6,910·89	....	42,601·00
			11,961·64	....	(*b*) 65,459·33
		OCHRE (RED).			
M.C.'s 26, 29	Murchison	Zadow, J. C.	186·00	....	(*a*) 1,860·00
		PYRITES ORE AND CONCENTRATES.		Sulphur recovered. tons.	
G.M.L.'s 1460, etc.	Dundas	Norseman G.M.'s N.L.	35,213·00	15,029·57	(*a*)163,514·00
		TALC.			
M.C. 14E	East Coolgardie	Bean, H.	56·00	....	210·00
Private Property (Three Springs)	O.P.G.	Universal Milling Co., Ltd.	200·00	....	2,490·00
			256·00	....	(*a*)(*c*)2,700·00
		TANTALITE (*e*) (*j*). (TANTALO/COLUMBITE.)	Ore and Concentrates. tons.	Combined Ta_2O_5 + Nb_2O_5. Units.	
M.C.'s 221, 222	Pilbara	McLeod, D.	(*k*) 2·29	143·23	749·15
M.C.'s 58, etc.	Greenbushes	Spring Valley Tin, Ltd.	(*l*) ·61	43·92	517·00
M.C.'s 56, etc.	Greenbushes	Freeman & Party	(*m*) 1·82	105·43	1,018·00
Sundry Claims	Greenbushes	Sundry Persons	(*n*) 1·97	106·33	573·70
			6·69	398·91	(*b*) 2,857·85

Table VII.—*Minerals other than Gold*—continued.

Quantity and Value of Minerals, other than Gold and Silver, reported during year 1950.

Number of Lease, Claim, or Area.	Goldfield or Mineral Field.	Registered Name of Producer.	Quantity.	Metallic Content.	Value.
		TIN (*e*).	tons.		£A.
D.C. 26	Pilbara	Johnston, J. A.	9·34	....	3,370·00
D.C. 16, etc.	Pilbara	Hansen & Johansson	·50	....	188·00
Crown Lands	Pilbara	Sundry Persons	11·23	....	4,918·80
M.C. 58, etc.	Greenbushes	Spring Valley Tin, Ltd.	(*o*) 15·04	....	8,663·40
M.C. 56, etc.	Greenbushes	Freeman, F.E.D.	9·51	....	3,669·65
M.C. 56, etc.	Greenbushes	Freeman & Party	(*p*) 5·79	....	4,686·00
			51·41	....	(*b*)25,495·85
		VERMICULITE.			
M.C. 187H (Young River)	O.P.G.	Perth Modelling Works, Ltd.	120·00	....	(*c*) 720·00

Yearly Disposal—(Perth Modelling Works, Ltd.).
Exfoliated for own use 59·00 tons producing 46·25 tons "Goldflake."
Crushed and sized ore exported from State 63·75 tons.

Number of Lease, Claim or Area.	Goldfield or Mineral Field.	Registered Name of Producer.	Quantity.	Metallic Content.		Value.
		LEAD ORE AND CONCENTRATES (*e*) (*g*).	tons.	Lead. tons.	Silver. fine ozs.	£A.
Loc. 833	Northampton	Heinsen Bros.	369·03	279·41	....	21,297·35
M.L.'s 205, etc.	do.	Galena Lead Mines, N.L.	152·47	98·35	10·57	7,769·80
M.L.'s 31PP, etc.	do.	Northampton Mining & Development Co. Pty., Ltd.	159·22	95·80	23·70	9,741·80
Loc. 832	do.	Isseka Mining Pty., Ltd.	13·48	9·37	....	1,088·50
M.L. 222	do.	Atkinson, R. S.	56·28	41·04	....	5,079·45
M.L. 39PP	do.	Mulligan's Mine Syndicate	84·74	65·01	....	6,798·95
Loc. 436	do.	Hernesniemi & Party	142·65	98·19	....	11,362·70
M.C. 6	do.	Normans Well Syndicate	8·92	5·69	....	696·30
M.L.'s 227, etc.	do.	Gabalong Asbestos Co. Pty., Ltd.	24·99	16·80	....	1,216·33
Loc. 334	do.	Thring, J.	18·48	13·19	....	1,034·00
M.L. 33PP	do.	Salter, J.	4·79	3·75	....	304·10
			1,035·05	726·60	34·27	(*b*)66,389·28
		SILVER LEAD ORE AND CONCENTRATES (*e*) (*g*) (*h*).				
M.C. 189	Pilbara	Moore, R. D.	430·66	301·27	3,909·06	22,447·60
M.C. 194	do.	Hedley, B.	8·15	2·97	....	100·00
M.C. 216	do.	Rogers, D. C.	6·41	4·37	44·97	343·70
M.C. 69	West Pilbara	Radley, C.	1·12	·52	12·76	40·80
Sundry Claims	do.	Sundry Persons	1·12	·52	12·76	40·80
M.L. 118	Ashburton	Rose, K.	50·13	38·94	493·78	3,179·45
M.L. 119	do.	Camp & Party	41·52	34·19	120·27	3,308·80
M.L. 121	do.	Gray, M. E.	24·24	16·50	168·58	1,685·95
M.L. 122	do.	Camp & Party	28·05	20·54	207·96	1,913·15
M.L. 126	do.	Rose & Johnson	30·86	24·70	244·10	2,354·75
M.L. 135	do.	Holben & Party	25·03	18·34	187·93	1,530·60
M.L. 136	do.	Francis, J. E.	1·85	·80	2·96	67·00
M.L. 142	do.	Gray & Party	2·04	1·36	13·06	92·05
M.L.'s 137, etc.	do.	Ashburton Mining and Minerals Pty., Ltd.	55·80	38·96	173·21	3,852·45
M.C. 2	do.	Ibbotson, G. R.	51·58	25·82	818·93	2,691·25
M.C.'s 5, 6	do.	Aerial Mines Pty., Ltd.	18·36	11·45	64·28	740·10
Sundry Claims	do.	Sundry Persons	15·98	11·59	76·53	937·70
			793·08	552·84	6,551·14	(*b*) 45,326·15

Number of Lease, Claim, or Area.	Goldfield or Mineral Field.	Registered Name of Producer.	Quantity	Metallic Content.			Value.
SILVER LEAD ZINC ORE AND CONCENTRATES (*e*) (*g*) (*h*).							
			tons.	Lead. tons.	Zinc. tons.	Silver. fine ozs.	£A.
M.C. 29	West Kimberley	Devonian Pty., Ltd.	7·83	3·48	·86	48·15	215·65
M.L. 224	Northampton....	Murchison View Syndicate	29·83	18·72	1·68	51·70	1,376·85
			37·66	22·20	2·54	99·85	1,592·50

TIN/TANTALITE/COLUMBITE DISPOSALS REPORTED TO THE DEPARTMENT DURING 1950—PARTICULARS OF THE SEPARATED PRODUCTS BEING INCLUDED IN THE RESPECTIVE MINERALS LISTED IN TABLE VII., ABOVE.

Producer.	Goldfield or Mineral Field.	Mineral Disposed.						Separation Obtained.				
				Assays, per cent.				Tantalite, Ore and Concentrates.			Tin Concentrates.	
		N.D.W. lb.	Material.	Sn.	Ta_2O_5.	Nb_2O_5	Ta_2O_5 plus Nb_2O_5	lb.	Combined Ta_2O_5 plus Nb_2O_5. lb.	Value.	lb.	Value.
										£A.		£A.
Freeman and Party (M.C.'s 56, etc.)	Greenbushes	17,869	T/T/C Conc.	50·1	†	†	18·50	4,086	2,362	1,018·00	12,963	4,686·00
McLeod, D. (M.C.'s 221, etc.)	Pilbara	5,123	T/C Ore		†	†	62·60	5,123	3,208	749·15	*Nil*	*Nil*
Spring Valley Tin, Ltd., M.C.'s 58, etc.	Greenbushes	7422	T/T/C Conc.	63·4	†	†	9·30	645	498	223·00	6,685	2,333·00
do. do.	do.	*2,184	T/T/C Conc.	57·7	†	†	*4·22	133	93	42·00	1,926	565·00
do. do.	do.	*7,441	T/T/C Conc.	59·8	†	†	* 5·27	586	393	252·00	6,782	2,368·00
Sundry Producers (Sundry Claims)	do.	‡19,524	T/T/C Conc.	†	†	†	*12·20	§4,423	2,382	573·70	†	†

REFERENCES.—T/C indicates Tantalite/Columbite. T/T/C indicates Tin/Tantalite/Columbite. * Estimated. † Not available. ‡ Forwarded to New South Wales in 1944, Tin content then separated and paid for. § Low grade residues held from 1944 awaiting favourable disposal. O.P.G. denotes Outside Proclaimed Goldfield. (*a*) Estimated Value F.O.R. (*b*) Estimated Value F.O.B. (*c*) Estimated Value At Works. (*d*) Estimated Value at Pit Head. (*e*) Only results from shipments finalised during the year are shown (outstanding shipments not recorded until Final Statements are received). (*f*) From 2·54 tons Copper Matte. (*g*) Metallic Content calculated on Assay basis. (*h*) Value expressed included any payment made for metallic contents other than Lead. (*i*) Used as flux in Iron Industry at Wundowie. (*j*) Metallic content realised. (*k*) From 2·29 tons Tantalite/Columbite Ore. (*l*) Separated from 7·61 tons Tin/Tantalite/Columbite concentrates. (*m*) Separated from 7·98 tons Tin/Tantalite/Columbite concentrates. (*n*) Separated from 8·77 tons Tin/Tantalite/Columbite concentrates. (*o*) Includes 6·87 tons from 7·61 tons Tin/Tantalite/Columbite concentrates. (*p*) Includes 5·79 tons from 7·98 tons Tin/Tantalite/Columbite concentrates.

TABLE SHOWING AVERAGE NUMBER OF MEN EMPLOYED ABOVE AND UNDER GROUND IN THE LARGER GOLDMINING COMPANIES OPERATING IN WESTERN AUSTRALIA DURING THE YEARS FROM 1941 TO 1950 INCLUSIVE.

Compiled from the Quarterly Figures furnished by Companies concerned to the Mines Department up to 1942 and Monthly Figures thereafter.

COMPANY.	1941.			1942.			1943.			1944.			1945.			1946.			1947.			1948.			1949.			1950.		
	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.
Boulder Perseverance, Ltd.	158	157	315	144	102	246	117	96	213	116	101	217	127	115	242	178	148	326	195	159	354	185	148	333	171	135	306	173	138	311
Broken Hill Pty. Co., Ltd.	48	93	141	32	54	86	5	....	5	4	....	4	11	2	13	33	82	115	38	95	133	38	84	122	36	73	109	34	68	102
Consolidated Gold Area, N.L.	24	38	62	27	33	60	13	16	29	1	....	1	1	....	1	2	....	2	2	....	2	2	....	2	1	....	1	1	....	1
Golden Horseshoe (New), Ltd.	50	....	50	41	....	41	39	....	39	38	....	38	39	....	39	45	....	45	46	....	46	45	....	45	43	....	43	41	....	41
Gold Mines of Kalgoorlie, Ltd.	105	167	272	91	108	199	95	96	191	90	98	188	103	114	217	144	171	315	169	158	327	166	173	339	175	179	354	187	180	367
Great Boulder Pty., Ltd.....	350	608	958	281	408	689	249	329	578	226	305	531	237	344	581	310	469	779	325	496	821	316	418	734	312	392	704	327	404	731
Kalgoorlie Enterprise, Ltd.	....	103	103	....	74	74	....	55	55	....	53	53	....	74	74	....	99	99	....	118	118	1	105	106	7	103	110	7	95	102
Lake View and Star, Ltd.	410	792	1,202	256	323	579	218	186	404	225	214	439	246	242	488	337	422	759	366	468	834	414	465	879	454	441	895	471	476	947
North Kalgurli (1912), Ltd.	82	286	368	48	154	202	37	91	128	42	107	149	52	131	183	62	173	235	66	213	279	76	265	341	79	304	383	90	316	406
Paringa Mining and Exploration Co., Ltd.	72	149	221	59	115	174	59	88	147	78	82	160	69	103	172	76	113	189	83	117	200	87	134	221	79	134	213	92	138	230
South Kalgurli Consolidated, Ltd.	151	143	294	131	98	229	67	77	144	43	74	117	51	80	131	80	91	171	103	105	208	107	111	218	110	105	215	120	107	227
Kalgurli Ore Treatment Co., Ltd.	80	....	80	67	....	67	65	....	65	67	....	67	68	....	68	73	....	73	69	....	69	69	....	69	74	....	74	74	....	74
New Milano, N.L.	29	17	46	20	15	35	6	8	14	1	....	1	2	....	2	2	1	3	2	2	4	2	1	3	1	....	1	1	....	1
Comet Gold Mines, Ltd.	44	36	80	59	31	90	54	28	82	47	30	77	42	33	75	43	32	75	17	7	24	7	10	17	9	13	22	11	12	23
Blue Spec Gold Mines, N.L.	9	4	13	6	4	10	5	4	9	28	7	35	32	12	44	38	17	55	36	24	60	17	12	29	1	....	1	20	6	26
Wiluna Gold Mines, Ltd.	255	342	597	247	292	539	255	282	537	237	244	481	214	196	410	168	96	264	117	5	122	69	....	69	49	....	49	29	....	29
Moonlight Wiluna Gold Mines, Ltd.	38	105	143	29	81	110	18	61	79	16	44	60	4	5	9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Emu Gold Mines, Ltd.	48	21	69	33	43	76	33	32	65	29	28	57	34	38	72	38	40	78	36	35	71	9	6	15	....	....	....	....	....	....
Youanmi Gold Mines, Ltd.....	56	140	106	10	12	22	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Big Bell Mines, Ltd.	180	237	417	165	162	327	29	11	40	14	1	15	29	16	45	171	143	314	186	198	384	188	193	381	197	210	407	219	246	465
Triton Gold Mines, N.L.	82	223	305	36	74	110	4	10	14	8	15	23	11	23	34	41	66	107	83	178	261	64	95	159	7	....	7	....	....	....
Hill 50 Gold Mine, N.L.	33	41	74	28	42	70	32	42	74	32	41	73	41	45	86	55	48	103	49	55	104	55	67	122	68	78	146	74	66	140
Mt. Magnet Gold Mines, Ltd.	9	4	13	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Sons of Gwalia, Ltd.	124	241	365	97	163	260	101	125	226	101	115	216	104	106	210	122	160	282	108	128	236	98	109	207	92	143	235	104	151	255
First Hit Gold Mine	20	14	34	18	12	30	17	15	32	21	14	35	20	15	35	7	7	14	4	5	9	2	1	3	1	1	2	1	1	2
Moonlight Wiluna Gold Mines, Ltd. (Timoni)	13	15	28	12	15	27	10	10	20	4	2	6	2	....	2	13	11	24	18	20	38	13	20	33	18	18	36	33	32	65
Ora Banda Amalgamated Ltd.	30	45	75	26	38	64	22	26	48	7	5	12	4	....	4	11	20	31	23	44	67	5	4	9	3	1	4	2	....	2
Consolidated Gold Mines of Coolgardie, Ltd.	67	86	153	45	53	98	37	44	81	20	23	43	8	1	9	2	....	2	1	....	1	1	....	1	1	....	1	1	....	1
Pheonix Gold Mines, Ltd.	54	65	119	43	40	83	35	36	71	40	38	78	48	33	81	50	30	80	50	30	80	33	22	55	....	....	....	....	....	....
Burbidge Gold Mines, N.L.....	38	....	38	25	2	27	3	....	3	....	....	....	....	....	....	18	....	18	15	4	19	14	4	18	18	4	22	16	4	20
Yellowdine Gold Development, Ltd.	57	74	131	41	47	88	30	28	58	13	9	22	2	....	2	4	....	4	2	....	2	2	....	2	2	....	2	1	....	1
Edna May Amalgamated, N.L.	39	62	101	29	35	64	30	35	65	35	36	71	33	34	67	29	42	71	28	33	61	11	9	20	....	....	....	....	....	....
Evanston Gold, N.L.	31	32	63	19	21	40	5	7	12	....	....	....	....	....	....	28	32	60	37	26	63	2	....	2	2	....	2	1	....	1
Central Norseman Gold Corporation, N.L.	112	223	335	91	148	239	82	117	199	72	115	187	77	135	212	103	201	304	111	251	362	117	268	385	133	246	379	163	236	399
*Norseman Gold Mines, N.L.	148	195	343	110	151	261	101	104	205	87	72	159	98	56	154	105	79	184	12	19	31	....	....	....	....	....	....	....	....	....
Sunshine Reward Amalgamated Leases	6	6	12	4	5	9	5	6	11	5	5	10	4	3	7	5	7	12	8	9	17	9	10	19	9	14	23	10	9	19
Dundas Gold Mines, N.L.	....	....	....	....	....	....	....	....	....	....	....	....	1	1	2	4	13	17	9	22	31	7	17	24	11	15	26	3	9	12
Mountain View Gold, N.L.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7	9	16	11	8	19	10	14	24	11	11	22
Mt. Charlotte (Kalgoorlie) Gold Mines, N.L.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	1	3	18	18	36	24	28	52	10	8	18
Porphyry (1939) Gold Mines Ltd.	29	17	46	27	23	50	5	4	9	1	....	1	6	....	6	13	5	18	15	10	25	17	4	21	20	....	20	19	1	20
New Coolgardie Gold Mines, N.L.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	12	9	21	78	64	142	73	125	198
All other Operators	2,790	2,454	5,244	1,447	1,301	2,748	599	495	1,094	511	437	948	599	388	987	1,002	674	1,676	1,174	993	2,167	1,127	972	2,099	965	825	1,790	985	837	1,822
State Average (incl. Diggers)	5,871	7,235	13,106	3,844	4,279	8,123	2,488	2,591	5,079	2,266	2,348	4,164	2,424	2,394	4,818	3,416	3,545	6,961	3,612	4,037	7,649	3,416	3,762	7,178	3,260	3,540	6,800	3,404	3,676	7,080
*Also additional men engaged exclusively on Pyrites Production	....	....	....	....	....	....	6	27	33	7	33	40	5	49	54	4	53	57	78	56	134	79	44	123	62	34	96	60	40	100

By Authority: WILLIAM H. WYATT, Government Printer, Perth.