CHAPTER XXI.

MINERAL INDUSTRY.

§ 1. The Mineral Wealth of Australia.

1. **Place of Mining in Australian Development.**—The value of production from the mineral industry is now considerably less than that returned by the agricultural or the pastoral industry, nevertheless it was the discovery of gold in payable quantities that first attracted population to Australia, and thus laid the foundation of its nationhood. Prior to 1851, the year when Hargraves' memorable discovery was made, coal and copper had both been mined to some extent, and the existence of deposits of other minerals, including gold, had been proved. But it was the news of the sensational finds of the precious metal in 1851 and the year immediately following that brought about a constant stream of immigration, and caused an increase in population from 221,000 at the end of 1841 to upwards of 1,168,000 at the end of 1861.

2. **Extent of Mineral Wealth.**—The extent of the total mineral wealth of Australia cannot yet be regarded as completely ascertained, as large areas of country still await systematic prospecting. The presence of considerable deposits of valuable minerals has long been known. Thus, coal was discovered in 1797, and a shipload was exported to Bengal in 1799, silver was discovered by Count Strezlecki as early as 1839, and was worked as early as 1864; copper mining dates back to 1844; lead to about 1848; iron to about 1850; while the discovery of gold in payable quantities dates back to 1851. Cobalt, nickel, manganese, chromium, tungsten, molybdenum, mercury, antimony, bismuth, zinc, radio-active ores, etc., have all been found, some in fairly large quantities.

Among the more valuable non-metalliferous substances may be mentioned coke, kerosene shale, graphite, alunite, asbestos, diatomaceous earth, phosphate, clays, ochres, etc.; in building stones—sandstones, syenites, granites, basalts, augite-andesite, porphyries, serpentines, slates, limestones, and marbles; in precious stones—diamonds, emeralds, rubies, sapphires, amethysts, precious opal, turquoise, topazes, garnets, chrysolites, cairngorm, agates, etc.

3. **Quantity and Value of Production during 1923.**—The quantities (where available) and the values of the principal minerals produced in each State, and in Australia as a whole during the year 1923, are given in the tables immediately following. It must be clearly understood that the figures quoted in these tables refer to the quantities and values of the various minerals in the form in which they were reported to the States Mines Departments, and represent amounts which the Mines Departments consider may fairly be taken as accruing to the mineral industry as such. They are not to be regarded as representative of Australia's potentiality as a producer of *metals*, this matter being dealt with separately in § 18 hereinafter. It may be explained, therefore, that the item pig-iron in New South Wales refers only to metal produced from locally-raised ore and so reported to the Mines Department. New South Wales is, of course, in normal times, a large producer of iron and steel from ironstone mined in South Australia. As the table shows, the latter State receives credit for this ironstone in its mineral returns, but the iron and steel produced therefrom cannot be apportioned to the mineral industry of New South Wales. Similarly lead, silver-lead, and zinc are credited in the form reported to the State of origin—chiefly New South Wales—although the actual metal extraction is carried out to a large extent elsewhere.

MINERAL PRODUCTION.—QUANTITIES, 1923.

Minerals.	Unit.	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T. (a)	Australia.
Alunite	ton	998	..	..	..	..	..	..	998
Antimony ..	,,	..	822	..	..	..	..	..	822
Arsenic	,,	11,493	..	610	..	Not stated	..	..	12,103
Asbestos ..	,,	204	..	..	7	115	..	..	326
Barytes	,,	100	..	..	1,761	..	..	..	1,861
Bismuth	cwt.	120	..	5	..	..	..	..	125
Brown coal ..	ton	..	116,888	..	..	..	..	..	116,888
Chromite ..	,,	1,192	..	..	..	..	..	..	1,192
Coal	,,	10,478,513	476,823	1,060,662	..	420,714	80,718	..	12,517,430
Cobalt	,,	..	..	218	..	..	..	..	218
Copper (ingot, matte, etc.) ..	,,	1,182	..	6,243	3,523	1,057	6,065	..	18,070
Copper ore ..	,,	79	..	..	..	3,394	..	4	3,477
Diatomaceous earth	,,	515	..	..	..	..	..	..	515
Gold	fine oz.	18,833	95,403	88,726	949	504,511	3,684	168	712,274
Gypsum	ton	2,070	12,761	..	53,405	..	..	..	68,236
Iron (pig) (c) ..	,,	94,350	..	..	..	..	..	...	94,350
Iron oxide ..	,,	2,716	..	..	..	..	..	..	2,716
Ironstone ..	,,	..	..	200	384,434	2	..	..	384,636
Kaolin	,,	3,632	2,307	..	..	..	..	..	5,939
Lead	,,	..	..	5,487	..	20	4,784	..	10,291
Lead and silver ore, concentrates, etc.	,,	241,761	..	..	2	3,172	..	..	244,935
Limestone flux ..	,,	131,843	..	95,158	94,020	..	100,113	..	421,134
Magnesite ..	,,	6,130	75	..	165	2	..	..	6,372
Manganese ore ..	,,	2,556	..	74	168	22	..	..	2,820
Molybdenite ..	cwt.	190	1,000	191	..	..	..	1	1,382
Osmiridium ..	oz.	..	..	..	..	..	673	..	673
Phosphate ..	ton	74	480	..	446	..	..	..	1,000
Pigments ..	,,	190	123	..	52	..	..	..	365
Platinum ..	oz.	586	..	..	..	..	..	..	586
Pyritic ore ..	ton	..	..	..	..	..	11,882	..	11,882
Salt	,,	..	(b)	..	50,286	..	..	..	50,286
Sapphires ..	oz.	1,034	..	Not stated	..	..	..	..	1,034
Shale (oil) ..	ton	1,207	..	..	..	..	1,101	..	2,308
Silver	fine oz.	107,682	6,304	469,302	43	109,005	638,602	..	1,330,938
Tin and tin ore ..	ton	896	78	903	..	131	1,160	136	3,304
Wolfram ..	,,	2	..	..	..	..	97	1	100
Zinc ores and concentrates ..	,,	426,049	..	..	..	..	..	..	426,049

(a) Year ended 30th June, 1922. (b) Not available for publication. (c) See letterpress preceding this table.

The comparative value of the minerals raised in each State during 1923 is given in the following table :—

MINERAL PRODUCTION.—VALUE, 1923.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T. (b)	Australia.
	£	£	£	£	£	£	£	£
Alunite	3,992	..	..	..	..	..	..	3,992
Antimony ..	..	14,112	..	..	..	..	..	14,112
Arsenic	28,178	..	27,780	..	686	..	..	56,644
Asbestos ..	4,267	..	..	161	4,032	..	..	8,460
Barytes ..	200	..	..	5,265	..	..	..	5,465
Bismuth ..	1,640	..	100	..	..	..	..	1,740
Brown coal ..	..	38,019	..	..	..	..	..	38,019
Chromite ..	3,082	..	..	..	..	..	..	3,082
Coal	8,607,892	525,270	925,227	..	368,949	70,797	..	10,498,135
Cobalt	..	..	43,449	..	..	..		43,449
Copper (ingot and matte) ..	81,203	..	430,746	232,172	16,193	435,413	..	1,195,727
Copper ore ..	1,172	..	..	..	48,907	..	30	50,109
Diamonds ..	230	..	..	..	..	..	..	230
Diatomaceous earth	1,098	..	..	..	..	..	..	1,098
Gold	83,325	422,105	392,563	4,199	2,232,179	16,300	743	3,151,414
Gypsum ..	360	10,176	..	46,729	..	..	..	57,265
Iron (pig) (c) ..	707,625	..	..	..	..	..	..	707,625
Iron oxide ..	3,081	..	..	..	..	..	..	3,081
Ironstone ..	..	..	150	445,303	9	..	..	445,462
Kaolin ..	5,158	2,384	..	..	..	..	..	7,542
Lead	..	..	147,233	..	609	127,542	..	275,384
Lead and silver-lead ore, concentrates, etc. ..	2,941,401	..	..	54	43,416	..	..	2,984,871

MINERAL PRODUCTION—VALUE, 1923—*continued.*

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T. (b)	Australia.
	£	£	£	£	£	£	£	£
Limestone flux ..	49,441	..	35,741	38,579	..	122,428	..	246,189
Magnesite ..	5,699	225	..	323	8	..	..	6,255
Manganese ore ..	7,748	..	332	1,581	200	..	..	9,861
Molybdenite ..	1,816	6,250	2,069	..	..	..	8	10,143
Opal	3,040	..	500	..	..	..	..	3,540
Osmiridium ..	..	..	..	..	..	19,642	..	19,642
Phosphate ..	132	713	..	592	..	..	..	1,437
Pigments ..	351	635	..	155	..	..	..	1,141
Platinum ..	10,204	..	..	..	..	..	..	10,204
Pyritic ore ..	..	..	..	..	..	26,737	..	26,737
Salt	..	(a)	..	113,143	..	..	..	113,143
Sapphires ..	3,282	..	23,309	..	..	..	..	26,591
Shale (oil) ..	2,831	..	..	..	..	1,094	..	3,925
Silver	15,461	963	69,412	6	16,036	91,339	..	193,217
Tin and tin ore ..	180,789	10,371	114,945	..	15,095	236,955	13,887	572,042
Wolfram ..	64	..	..	..	..	6,150	18	6,232
Zinc concentrates	1,411,652	..	..	..	..	..	..	1,411,652
Unenumerated ..	10,274	..	1,942	2,116	782	..	1,926	17,040
Total ..	14,176,688	1,031,223	2,215,498	890,378	2,747,101	1,154,397	16,612	22,231,897

(a) Not available for publication. (b) Year ended 30th June, 1922. (c) See letterpress page 764.

It may be pointed out in connexion with the figures given in the above table that the totals are exclusive of returns relating to certain commodities, such as stone for building and industrial uses, sand, gravel, brick and pottery clays, lime, cement, and slates, which might rightly be included under the generic term "mineral." Valuations of the production of some of these may be obtained from the reports of the various Mines Departments, but in regard to others it is impossible to obtain adequate information. In some instances, moreover, the published information is of little value. By restricting the comparison to items in connexion with which properly comparable information can be obtained for each State, it is believed that a satisfactory estimate of the progress of the mineral industry can be more readily obtained. The items excluded from the total for New South Wales in 1923 consist of—lime, £92,387; marble, £1,510; slate, £90; Portland cement, £1,025,687; coke, £941,323; chert, £1,820; granite, £1,965; shell grit, £580; mineral water, £824; sulphur (obtained from roasting concentrates), £31,880; and brick and pottery clays, £13,415. From the Queensland returns, marble, £964 has been deducted, from South Australia, sulphuric acid, £4,892, while the item carbide, £64,720, has been excluded from the Tasmanian figures.

4. Value of Production, 1919 to 1923.—The value of the mineral production in each State during the five years 1919 to 1923 is given in the table hereunder :—

MINERAL PRODUCTION.—VALUE, 1919 TO 1923.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T.	Australia.
	£	£	£	£	£	£	£	£
1919 ..	8,911,725	1,151,980	2,575,225	771,659	4,191,973	1,307,692	71,697	18,981,951
1920 ..	9,791,979	1,435,135	3,617,870	1,150,849	4,110,376	1,426,442	80,101	21,612,752
1921 ..	12,052,509	1,218,783	1,495,899	904,659	3,463,764	822,767	19,003	19,977,384
1922 ..	12,951,164	1,244,966	1,859,084	331,866	3,041,112	878,009	9,959	20,316,160
1923 ..	14,176,688	1,031,223	2,215,498	890,378	2,747,101	1,154,397	16,612	22,231,897

For New South Wales the production in 1913 was the highest recorded.

The low value returned in 1919 was due chiefly to cessation of operations for a large portion of the year at the Broken Hill mines, and partly to the dry conditions prevailing over an extensive area of the State. In Queensland the falling-off in 1921 was occasioned by the low prices realised for the principal industrial metals. None of the copper companies in the Cloncurry district resumed operations, and Mount Morgan, which in previous years contributed about 30 per cent. of the State's mineral

yield, closed down early in the year. Increases in the returns from copper, lead, silver, cobalt, and tin mainly accounted for the rise in value of production for 1923. The low returns in South Australia for 1921 were due to the small production of copper, and this was followed by a still smaller yield in 1922, when the value dwindled to £74,000, the least return since 1844. A further factor in the reduction of the total for 1922 was the temporary cessation of operations at the ironstone deposits at Iron Knob, the value of the ore raised being £58,000, as compared with £587,000 in 1921. The improvement in the returns for 1923 was mainly accounted for by increases in the production from ironstone and copper which amounted to £387,000 in the case of ironstone, and £158,000 in the case of copper, over the figures for 1922. In Western Australia the gold yield in 1923 again showed a decline, being upwards of £1,243,000 less than in 1920. High cost of mining requisites, coupled with the depressed market for base metals, account for the restricted output generally. The collapse in the market for industrial metals, in conjunction with the increased cost of production, brought about the fall in production during 1921 in Tasmania. Improvement in the returns for tin, copper, lead, and coal was responsible for the increase in 1923. The stagnation in the base metal industry is reflected in the Northern Territory returns for 1922.

5. **Total Production to end of 1923.**—In the next table will be found the estimated value of the total mineral production in each State up to the end of 1923. The figures given in the table are also exclusive of the same items referred to in connexion with the preceding table. Thus the total for New South Wales falls short by £18,910,000 of that published by the State Department of Mines, the principal items excluded being coke, £8,199,000; cement, £8,093,000; lime, £929,000; and marble, £46,000.

MINERAL PRODUCTION.—VALUE TO END OF 1923.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor.Ter.(a)	Australia.
	£	£	£	£	£	£	£	Million £
Gold ..	63,452,856	302,355,058	84,930,396	1,617,380	152,529,446	8,854,227	2,276,460	616
Silver and lead ..	94,871,079	263,083	3,573,719	378,358	1,918,616	7,424,276	62,515	108
Copper ..	15,415,953	216,656	25,059,425	33,015,276	1,746,122	16,875,466	232,538	93
Iron ..	5,109,552	15,641	471,934	3,391,537	36,721	52,110	..	9
Tin ..	12,841,235	925,986	10,115,593	..	1,510,066	15,568,358	539,967	42
Wolfram .	271,706	11,885	1,061,419	301	1,441	179,467	216,859	2
Zinc ..	16,296,566	..	..	15,993	5,437	36,320	..	16
Coal ..	132,061,846	7,060,770	12,218,689	..	3,831,878	1,207,532	..	156
Other ..	7,174,621	747,780	2,517,368	2,626,812	121,715	770,545	32,542	14
Total	347,495,414	311,596,859	139,948,543	41,045,657	161,701,442	50,968,301	3,360,881	1,056

(a) To 30th June, 1923.

The "other" minerals in New South Wales include alunite, £200,319; antimony, £344,588; bismuth, £226,419; chrome, £117,602; diamonds, £143,714; limestone flux, £997,920; molybdenite, £216,143; opal, £1,529,394; scheelite, £192,375; and oil shale, £2,689,347. In the Victorian returns antimony ore was responsible for £592,133. The value for coal in this State includes £256,172 for brown coal. Included in "other" in the Queensland production were opal, £181,195; gems, £560,797; bismuth, £309,435; molybdenite, £406,737; and limestone flux, £701,058. The chief items in South Australian "other" minerals were salt, £1,608,767; limestone flux, £292,291; gypsum, £283,551; and phosphate, £127,859. In the Tasmanian returns limestone flux was responsible for £214,167, and osmiridium for £297,580, while the figures for recent years include values for iron pyrites.

6. **Decline in the Metalliferous Industry.**—On the 1st December, 1921, a Select Committee was appointed by the Legislative Assembly of New South Wales to inquire into and report upon the serious decline in the metalliferous industry. The result of the Committee's investigations was published in a Report issued in 1922, wherein the chief contributing causes of the decline in New South Wales and in Australia generally were summarized as follows:—(1) High cost of production. (2) Deterioration in ore values in existing mines. (3) Inadequate machinery. (4) High freights. (5) High treatment charges. (6) Imperfect labour conditions in mines. (7) Lack of new payable discoveries. (8) Lack of efficiently-supported prospecting.

§ 2. Gold.

1. **Discovery in Various States.**—The discovery of gold in payable quantities was an epoch-making event in Australian history, for, as one writer aptly phrases it, this event "precipitated Australia into nationhood." A more or less detailed account of the finding of gold in the various States appears under this section in Official Year Books Nos. 1 to 4, but considerations of space preclude its repetition in the present issue.

2. **Production at Various Periods.**—In the following table will be found the value of the gold raised in the several States and in Australia as a whole during each of the six decennial periods from 1851 to 1910, and in single years from 1911 to 1923, from the dates when payable discoveries were first reported. Owing to defective information in the earlier years the figures fall considerably short of the actual totals, for during the first stages of mining development, large quantities of gold were taken out of Australia by successful diggers, who preferred to keep the amount of their wealth secret. For South Australia the records in the earlier years are somewhat irregular, and this remark applies to some extent also to the returns for Western Australia and Tasmania.

GOLD.—VALUE OF PRODUCTION, 1851 TO 1923.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.	Australia.
	£	£	£	£	£	£	£	£
1851–60..	11,530,583	93,337,052	14,565	..	..	788,564	..	105,670,764
1861–70..	13,676,103	65,106,264	2,076,494	..	..	12,174	..	80,871,035
1871–80..	8,576,654	40,625,188	10,733,048	579,068	..	700,048	79,022	61,293,028
1881–90..	4,306,541	28,413,792	13,843,081	246,668	178,473	1,514,921	713,345	49,216,821
1891–1900	10,332,120	29,904,152	23,989,359	219,931	22,308,524	2,338,336	906,988	89,999,410
1901–10..	9,569,492	30,136,686	23,412,395	310,080	75,540,415	2,566,170	473,871	142,009,109
1911 ..	769,353	2,140,855	1,640,323	15,000	5,823,075	132,108	30,910	10,551,624
1912 ..	702,129	2,039,464	1,477,979	28,000	5,448,385	161,300	22,671	9,879,928
1913 ..	635,703	1,847,475	1,128,768	27,800	5,581,696	141,876	13,250	9,376,568
1914 ..	528,873	1,755,236	1,059,674	25,581	5,237,350	111,475	10,757	8,729,946
1915 ..	562,819	1,397,793	1,060,703	25,830	5,140,226	78,784	3,781	8,269,936
1916 ..	459,370	1,090,149	913,951	33,000	4,508,529	67,072	3,861	7,075,932
1917 ..	349,038	857,497	761,639	30,334	4,121,642	61,577	3,677	6,185,404
1918 ..	369,743	674,655	567,371	26,252	3,723,180	44,724	2,229	5,408,154
1919 ..	336,240	691 632	618,101	16,465	3,748,882	39,252	4,234	5,454,806
1920 ..	275,109	859,461	648,168	9,546	3,475,386	35,134	5,282	5,308,086
1921 ..	271,302	554,087	214,060	13,933	2,935,693	28,311	1,299	4,018,685
1922 ..	118,359	501,515	378,154	4,693	2,525,811	16,101	540	3,545,173
1923 ..	83,325	422,105	392,563	4,199	2,232,179	16,300	743	3,151,414
Total ..	63,452,856	302,355,058	84,930,396	1,617,380	152,529,446	8,854,227	2,276,460	616,015,823

The value of the gold yield in 1923 was the lowest recorded since the discovery of the precious metal in 1851.

The amount of gold raised in Australia in any one year attained its maximum in 1903, in which year Western Australia also reached its highest point. For the other States the years in which the greatest yields were obtained were as follows:—New South Wales, 1852; Victoria, 1856; Queensland, 1900; South Australia, 1904, and Tasmania, 1899.

The following table shows the quantity in fine ounces of gold raised in each State and in Australia during each of the last five years, the value of one ounce fine being taken at £5 2s. 1½d. in 1919, at £5 12s. 6d. in 1920, at £5 6s. 0½d. in 1921, at £4 13s. 10¼d. in 1922, and at £4 8s. 5¾d. in 1923.

GOLD.—QUANTITY PRODUCED, 1919 TO 1923.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tasmania.	Nor. Ter.	Australia.
	Fine ozs.	*Fine ozs.*	*Fine ozs.*	*Fine ozs.*	*Fine ozs.*	*Fine ozs.*	*Fine ozs.*	*Fine ozs.*
1919 ..	65,839	135,428	121,030	3,224	734,066	7,686	(a) 829	1,068,102
1920 ..	48,908	152,792	115,229	1,697	617,843	6,246	(a) 939	943,654
1921 ..	51,173	104,512	40,376	2,628	553,731	5,340	(a) 245	758,005
1922 ..	25,222	106,872	80,584	1,000	538,246	3,431	(a) 115	755,470
1923 ..	18,833	95,403	88,726	949	504,511	3,684	(a) 168	712,274

(a) Year ended 30th June.

Unfortunately the general decline which has characterized Australia's gold output for a number of years has not been checked by any new finds of importance, and, unless economies can be carried out, the fall in price of gold will have a depressing effect on production.

3. **Changes in Relative Positions of States as Gold Producers.**—A glance at the figures in the table showing the value of gold raised will sufficiently explain the enormous increase in the population of Victoria during the period 1851 to 1861, when an average of over 40,000 persons reached the State each year. With the exception of the year 1889, when its output was surpassed by that of Queensland, Victoria maintained its position as the chief gold-producer for a period of forty-seven years, or up to 1898, when its production was outstripped by that of Western Australia, the latter State from this year onward contributing practically half, and so far as recent years are concerned more than half the entire yield of Australia. New South Wales occupied the second place on the list until 1874, when Queensland returns exceeded those of the parent State, and, with the exception of the year 1921, maintained this pre-eminence to the end of 1923. South Australia has occupied the position of lowest contributor to the total gold yield since the year 1871. Taking the average of the last ten years, the relative position of each State in regard to the gold production of Australia was as follows :—

GOLD.—RELATIVE POSITION OF STATES AS PRODUCERS, 1914 TO 1923.

State.	Annual Average of Gold Production, 1914 to 1923.	Percentage on Total.	State.	Annual Average of Gold Production, 1914 to 1923.	Percentage on Total.
	Ozs.			Ozs.	
Total	1,263,461	100.0	New South Wales	74,434	5.9
Western Australia	829,972	65.7	Tasmania ..	11,199	0.9
Victoria	195,465	15.5	South Australia ..	4,293	0.3
Queensland ..	147,316	11.6	Northern Territory	782	0.1

4. **Methods of Gold Mining adopted in Each State.**—(i) *New South Wales.* In New South Wales the earlier "rushes" were to surface alluvial or shallow-sinking grounds. Many of these were apparently soon worked out, but there is reason to believe that in some instances payable results would be obtained by treating the rejected wash-dirt on more scientific principles. With the exhaustion of the surface deposits, discoveries were made by sinking to what are called deep alluvial leads, representing the beds of old drainage channels in Pliocene and Pleistocene times. The first of these deep alluvial leads was discovered at Forbes, in New South Wales, in 1862. The Tertiary deep leads at Gulgong were discovered in 1871. Cretaceous leads occur at Tibooburra, and detrital gold has been found in permo-carboniferous conglomerates at Tallawang. The method of dredging is extensively used for winning gold from the beds of running streams, and from loose river flats and other wet ground where sinking would be impracticable. The system was introduced from New Zealand, where it was originally applied with great success on the Clutha River, and practically all the auriferous rivers of New South Wales have been worked by dredges. Hydraulic sluicing is employed also in several places, the necessary machinery being fitted to a pontoon for convenience in moving from place to place. The quantity of alluvial gold obtained, other than by dredging, amounted to 1,178 ozs. in 1923, the chief yields being obtained in the Tumut and Adelong District, 280 ozs.; Bathurst, 234 ozs.; Peel and Uralla, 198 ozs.; and Tambaroora and Turon Division, 134 ozs. The quantity obtained by dredging was 8,331 ozs.; the largest returns being obtained at Gundagai (Lachlan) 2,795 ozs.; Adelong (Tumut and Adelong District) 4,708 ozs.; and Araluen (Southern) 1,073 ozs. During 1923, the combined value of the dredging plants in the various areas was £72,048, but only 4 dredges were in operation. The quantity of gold won from quartz amounted to 4,219 ozs. In order of importance the yields in mining districts were—Southern, 1,096 ozs.; Lachlan, 938 ozs.; Bathurst, 710 ozs.; Tambaroora and Turon, 667 ozs.; Mudgee, 212 ozs. From the Cobar District, which for many years was the principal producer, the yield in 1923 was only 77 ozs., as compared with over 3,000 ozs. in 1922.

(ii) *Victoria.* Lode mining predominates in Victoria, although gold is also obtained from alluvial workings, both surface and deep leads. Owing to the exhaustion of much of the payable auriferous area the yield has been on the down grade for the last sixteen years, and the return for 1923 was the lowest experienced since 1851. The deepest mines in Australia are found in the Bendigo district, where there are two shafts 4,614 and 4,318 feet deep respectively. (It may be interesting to note here that the deepest mine in the world is the St. John del Rey in Brazil, where the workings reach a vertical depth of 6,726 feet from the surface. The Village Deep in the Transvaal is 6,263 feet deep, while two shafts on the Kolar goldfield in India reach over 6,000 feet). A considerable amount of attention is given to dredging and hydraulic sluicing, particularly in the Beechworth, Maryborough, Castlemaine, Ararat, Stawell, Gippsland, and Ballarat districts. The yields from alluvial and quartz respectively as returned (in crude ounces) from the chief mining districts of the State during 1923 were as follows:—Ararat and Stawell, 4,647 and 516; Ballarat, 1,007 and 785; Beechworth, 7,871 and 25,067; Bendigo, 361 and 44,896; Castlemaine, 1,763 and 15,751; Gippsland, 1,198 and 469; Maryborough 387 and 477.

The largest output from quartz mining in the Bendigo district was furnished by the New Red, White, and Blue, with 19,068 ozs., valued at £72,672; followed by the Hercules and Energetic, 5,412 ozs., £21,514; Ulster, 1,798 ozs., £7,066; and Lansell's North Red, White, and Blue, 1,440 ozs, £5,760. In the Beechworth district the Morning Star Co., at Wood's Point, returned 17,348 ozs., valued at £59,161; the Rose, Thistle and Shamrock at Harrietville, 3,378 ozs., £13,979; and the A.I. Gold Mines at Gaffney's Creek, 861 ozs., £3,347. In the Daylesford area of the Castlemaine district the Ajax returned 8,070 ozs., £33,123; and Ajax North, 2,586 ozs., £10,350. At Tarrengower, Oswald's G.M. Co. produced 1,748 ozs., valued at £6,990. The only yield of importance in the Ballarat area was obtained by the Yankee Reef Syndicate at Blackwood, with 819 ozs., valued at £3,276.

From alluvial the principal yield was obtained by Cock's Pioneer Gold and Tin Mines, with 6,261 ozs., valued at £25,044. This Company, which operates in the Beechworth district, also produced about £10,000 worth of tin during the year. The New Langi Logan at Ararat returned 3,068 ozs., valued at £12,239. In the Gippsland area the Tongio Gold Dredging Co. at Omeo obtained 679 ozs., valued at £2,716.

(iii) *Queensland.* Operations in Queensland are chiefly confined to reefing, and to the production of gold in connexion with the smelting of copper and other ores, the yield from alluvial in 1923 being only 455 ozs., of which 289 ozs. were obtained at Batavia River, while the quantity produced from stone treated was 21,262 ozs.; from copper and other ores 64,828 ozs.; and from old tailings 2,181 ozs.; making a total production of 88,726 ozs. The yields from the principal fields were—Mount Morgan, 64,362 ozs.; Charters Towers, 2,787 ozs.; Gympie, 7,437 ozs.; Chillagoe, 1,379 ozs.; Etheridge, 1,650 ozs.; Ravenswood, 3,289 ozs.; and Mount Coolon, 6,139 ozs. Practically three-fourths of the entire production came from Mount Morgan, the yields from Gympie and Charters Towers being much below those of the preceding year. The once famous Charters Towers field is apparently approaching exhaustion.

(iv) *South Australia.* Gold is found in widely-scattered localities in South Australia, but the production has at no period been large. Alluvial gold is produced by the Echunga, Teetulpa, Barossa, and Ulooloo fields. Within recent years the chief source of the metal has been the copper ore of Wallaroo and Moonta, from which it is recovered by smelting and electrolytic refining.

(v) *Western Australia.* The auriferous deposits of Western Australia may be grouped under three headings—(1) superficial deposits, (2) deposits in beds of conglomerate, and (3) lode and vein deposits. The first class includes a number of deposits of alluvial type, either in the beds of existing watercourses or in deep leads, up to 100 feet or more below present surface level. Associated with these are deposits of crystalline gold in "pug," oxide of iron, and soft weathered portions of underlying bed rock. Considerable areas of auriferous surface soil are also found, and these have apparently originated from the denudation by weathering of the bed rock and its associated veins. The shallow surface deposits have been worked by ground sluicing wherever water was available, but most of the ground has been worked by "dry-blowing." The pug and clayey bedrock are usually treated in puddling machines. In regard to (2) it may be noted that in several localities on the Pilbara goldfield and in one on the Yalgoo, gold has been found in conglomerate of the Nullagine series of rocks, now tentatively accepted

as of Cambrian age. The gold is crystalline and is confined to the interstitial cementing material. Occasional occurrences of gold are met with in laterite conglomerate of tertiary and post-tertiary age, and at Kintore in conglomerate of the same age. Lode and vein deposits alluded to in (3) are found in great variety in Western Australia. The gold is always found associated with iron pyrites in the unoxidized portions of the lodes, and often also with copper pyrites, arsenical pyrites and galena. Tellurides of gold occur at times.

The yields from the principal fields in order of importance were as follows:—East Coolgardie, 370,670 ozs.; Murchison, 27,037 ozs.; Mt. Margaret, 26,876 ozs.; Coolgardie, 13,077 ozs.; North Coolgardie, 12,213 ozs.; East Murchison, 11,016 ozs.; Yilgarn, 8,376 ozs.; Yalgoo, 7,713 ozs.; Dundas, 6,538 ozs.; North-East Coolgardie, 4,714 ozs.; Broad Arrow, 2,741 ozs.; Pilbara, 2,544 ozs.; and Peak Hill, 1,700 ozs. Of the total yield of 495,672 ozs. reported to the Mines Department, 490,312 ozs. were obtained from ore treated, 4,162 ozs. from dollied and specimens, while the return from alluvial was about 1,200 ozs. The total referred to differs somewhat from that quoted in the first table in this chapter, which represents gold exported and minted. It may be noted here that the total amount of dividends paid by Western Australian mining companies to the end of the year 1923 was £28,381,000.

Western Australia reached its zenith as a gold-producer in 1903, when the output was valued at £8,771,000, but since then there has been a more or less steady decline until in 1923 the total had dropped to £2,232,000. Three causes may be adduced to account for this falling-off—(1) Exhaustion of known rich deposits. (2) Unwise development, *i.e.*, "picking the eyes" of good mines. (3) Increased cost of stores, equipment and labour, rendering it unprofitable to treat low-grade ores.

(vi) *Tasmania.* The yield in Tasmania is chiefly obtained from reefing, and the returns from the principal districts in 1923 were as follows:—North-West and West Coasts, 2,034 ozs.; Mathinna, 1,001 ozs.; Lisle Golconda, 201 ozs.; Mt. Claude, 160 ozs.; Beaconsfield, 206 ozs.; and smaller quantities from Mt. Cameron, Mt. Victoria, and Warrentinna.

The total production was equal to 3,684 ozs. fine. During 1923 the blister copper produced by the Mt. Lyell Mining and Railway Co. Ltd. contained approximately 1,996 ozs. of gold.

(vii) *Northern Territory.* The production for 1923 amounted to only 207 ozs. It is stated that the potentialities of the older fields have by no means been exhausted, although a revival of the industry depends on the expenditure of large sums of money, either by the Government or by mining speculators, on developmental work. Of the total yield 107 ozs. came from the Golden Dyke mine, 22 ozs. from Watt's Creek, and 45 ozs. from Tanami.

5. Remarkable Masses of Gold.—Allusion has already been made in preceding Year Books to the discovery of "nuggets" and other remarkable masses of gold, but it is not proposed to repeat this information in the present issue. (See Year Book No. 4, page 500.)

6. Modes of Occurrence of Gold in Australia.—This subject has been alluded to at some length in earlier issues of the Year Book, but considerations of space will not permit of repetition in the present issue.

7. Place of Australia in the World's Gold Production.—In the table given below will be found the estimated value of the world's gold production, and the share of Australia therein during the five years 1919 to 1923. The figures given in the table have been compiled chiefly from returns obtained directly by the Commonwealth Bureau of Census and Statistics from the gold-producing countries of the world.

GOLD.—WORLD'S PRODUCTION, 1919 TO 1923.

Year.	World's Production of Gold.	Gold Produced in Australia.	Percentage of Australia on Total.
	£	£	%
1919	88,244,000	5,455,000	6.2
1920	90,730,000	5,308,000	5.9
1921	83,772,000	4,019,000	4.8
1922	71,653,000	3,545,000	4.9
1923	78,367,000	3,151,000	4.0

The value of the gold yield in the ten chief producing countries during each of the five years 1919 to 1923 is given in the table hereunder. Particulars of the quantity and value of the gold production for all countries for the ten years 1914–23 will be found in the Bulletin of Australian Production issued by this Bureau.

GOLD.—PRODUCTION, CHIEF COUNTRIES, 1919 TO 1923.

Country.	1919.	1920.	1921.	1922.	1923.
	£	£	£	£	£
Union of South Africa	42,550,000	45,892,000	43,096,000	32,895,000	40,480,000
United States ..	14,695,000	13,581,000	12,519,000	10,743,000	10,736,000
Canada	3,916,000	4,303,000	4,911,000	5,929,000	5,457,000
Australia	5,455,000	5,306,000	4,018,000	3,545,000	3,153,000
Mexico	3,873,000	4,154,000	3,626,000	3,512,000	3,437,000
Rhodesia	3,030,000	3,108,000	3,104,000	3,063,000	2,865,000
India	2,304,000	2,609,000	2,073,000	1,832,000	1,697,000
Colombia	1,482,000	1,578,000	1,539,000	1,201,000	1,220,000
Japan	1,309,000	1,499,000	1,408,000	1,239,000	1,154,000
Gold Coast	1,508,000	1,167,000	1,078,000	998,000	883,000

It has been deemed advisable to apportion values in accordance with Australian currency, i.e., at £5 2s. $1\frac{1}{25}$d. for 1919, £5 12s. 6d. for 1920, £5 6s. $0\frac{2}{5}$d. for 1921, £4 13s. $10\frac{1}{4}$d. for 1922, and £4 8s. $5\frac{3}{4}$d. for 1923.

The next table shows the average yearly value in order of importance of the yield in the chief gold-producing countries for the decennium 1914–23 :—

GOLD.—AVERAGE ANNUAL PRODUCTION, CHIEF COUNTRIES, 1914 TO 1923.

Country.	Value.	Country.	Value.
	£		£
Union of South Africa ..	39,277,000	Mexico	2,906,000
United States	15,143,000	India	2,181,000
Australia	5,715,000	Gold Coast	1,362,000
Canada	4,176,000	Japan	1,280,000
Rhodesia	3,286,000	Columbia	1,220,000
Russia	3,164,000		

The comparison has been restricted to countries where the average for the period is in excess of a million sterling.

8. Employment in Gold Mining.—The number of persons engaged in gold mining in each State in 1901 and during each of the last five years is shown in the following table :—

GOLD MINING.—PERSONS EMPLOYED, 1901, AND 1919 TO 1923.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.	Total.
	No.	No.	No.	No.	No.	No.	No	No.
1901 ..	12,064	27,387	9,438	1,000	19,771	1,112	200	70,972
1919 ..	1,656	3,065	792	100	7,242	73	60	12,988
1920 ..	1,712	3,742	611	100	7,087	48	20	13,320
1921 ..	1,516	3,050	722	100	6,019	67	10	11,484
1922 ..	1,197	3,310	767	40	5,787	106	12	11,219
1923 ..	1,141	2,982	603	32	5,555	119	30	10,462

The heavy decline noticeable since 1901 is of course due to the exhaustion of accessible payable deposits and the failure to locate any considerable fresh sources of supply.

§ 3. Platinum and Platinoid Metals.

1. **Platinum.**—(i) *New South Wales.* The deposits at present worked in the State are situated at Platina in the Fifield division, near Parkes, and the production in 1923 amounted to 586 ozs., valued at £10,204, as compared with 80 ozs., valued at £1,182 in the preceding year, while the total production recorded to the end of 1923 amounted to 16,604, ozs., valued at £79,233. Production was stimulated by the local price for the metal, £19 per oz., and if a permanent water supply were assured the industry could afford a livelihood for a much larger number than the 60 men engaged in it during 1923.

(ii) *Victoria.* In Gippsland the metal has been found in association with copper, and 127 ozs. were produced in 1913, but there was no production in recent years.

(iii) *Queensland.* Platinum associated with osmiridium has been found in the beach sands between Southport and Currumbin, in creeks on the Russell gold-field near Innisfail, and in alluvial deposits on the Gympie gold-field, but no production has been recorded.

2. **Osmium, Iridium, etc.**—(i) *New South Wales.* Small quantities of osmium, iridium, and rhodium are found in various localities. Platinum, associated with iridium and osmium, has been found in the washings from the Aberfoil River, about 15 miles from Oban; on the beach sands of the northern coast; in the gem sand at Bingara, Mudgee, Bathurst, and other places. In some cases, as for example in the beach sands of Ballina, the osmiridium and other platinoid metals amount to as much as 40 per cent. of the platinum, or about 28 per cent. of the whole metallic content.

(ii) *Victoria.* In Victoria, iridosmine has been found near Foster, and at Waratah Range, South Gippsland.

(iii) *Tasmania.* For many years osmiridium has been known to exist in the bed of the Savage River, on the West Coast, and in rivulets and creeks in the serpentine country. The first recorded production was in 1910, when 120 ozs., valued at £530, or £4 8s. 4d. per oz., were raised. In 1914 the yield had increased to 1,019 ozs., valued at £10,076, or nearly £9 18s. per oz. From 1915 to 1917 the amount raised fell off considerably, owing to difficulty in disposing of the metal, but in 1918 there was an increase to 1,607 ozs., valued at £44,833; while in 1920 the 2,009 ozs. produced returned £77,114, or over £38 7s. 8d. per oz. In October of that year as much as £42 per oz. was obtained. For 1921 the production was 1,751 ozs., valued at £42,935, or about £24 10s. per oz. The price obtained in 1921, varied from £35 in January to £27 10s. in April, May, and June, to £23 in July and August, and to £20 from September to the close of the year. For 1922 the output reached 1,174 ozs., valued at £35,512. In 1923 the yield amounted to 673 ozs., valued at £19,642.

§ 4. Silver and Lead.

1. **Occurrence in Each State.**—Particulars regarding the occurrence of silver in each State will be found in preceding Year Books, Nos. 1 to 5, but considerations of space preclude the repetition of this matter in the present volume.

2. **Development of Silver Mining.**—The value of the production of silver, silver-lead and ore, and lead from each State during the five years ending 1923 is given hereunder :—

SILVER AND LEAD.—PRODUCTION, 1919 TO 1923.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.	Australia.
	£	£	£	£	£	£	£	£
1919 ..	1,647,878	1,607	28,511	180	107,508	136,234	(a)132	1,922,050
1920 ..	123,481	1,714	135,559	2,646	190,484	309,035	(a)299	763,218
1921 ..	1,327,364	862	54,188	240	67,521	89,817	..	1,539,992
1922 ..	2,574,108	1,080	109,350	377	87,692	241,694	..	3,014,301
1923 ..	2,956,862	963	216,645	60	60,061	218,881	..	3,453,472

(a) Year ended 30th June.

The heavy falling-off in the production for 1919 and 1920 as compared with previous years was due to the suspension of operations owing to industrial troubles at the principal mines on the Broken Hill field. In addition to causing a cessation of mining operations and treatment of tailings on the Broken Hill field, the smelting works at Cockle Creek, upon which most of the silver-lead mines in other parts of the State depend for the sale of their ores, were forced to close. The resumption of normal production in 1921 by the mines on the Broken Hill field was largely hindered by the low price of lead, and the destruction by fire of the smelting works at Port Pirie.

It must be understood that the totals for New South Wales in the above table represent the *net* value of the product (excluding zinc) of the silver-lead mines of the State. In explanation of the values thus given, it may be noted that the metallic contents of the larger portion of the output from the silver-lead mines in the State are extracted outside New South Wales, and the Mines Department considers, therefore, that the State should not take full credit for the finished product. The real importance of the State as a producer of silver, lead, and zinc is thus to some extent lost sight of. The next table, however, which indicates the quantity of these metals locally produced, and the average contents by assay of concentrates exported during the last five years, will show, as regards New South Wales, the estimated total production and the value accruing to Australia from the three metals :—

SILVER-LEAD MINES.—NEW SOUTH WALES, TOTAL PRODUCTION, 1919 TO 1923.

Year.	Metal Produced within Australia.				Contents of Concentrates Exported.			
	Silver.	Lead.	Zinc.	Value.	Silver.	Lead.	Zinc.	Value.
	ozs. fine.	tons.	tons.	£	ozs. fine.	tons.	tons.	£
1919 ..	5,886,947	80,175	(a)7,119	4,109,466	417,871	2,425	18,146	253,751
1920 ..	196,111	1,749	(a)10,565	515,728	479,221	3,025	21,742	274,061
1921 ..	3,624,413	47,426	(a)1,425	1,723,864	617,477	6,539	19,272	261,238
1922 ..	6,648,825	97,867	23,724	4,113,427	3,264,102	19,328	132,186	1,272,074
1923 ..	7,233,236	124,570	41,153	5,707,739	4,834,718	40,906	149,319	1,813,287

(a) Including Zinc Oxide and Zinc Lead Oxide.

The figures given above are quoted on the authority of the Mines Department of New South Wales.

3. Sources of Production.—Broken Hill, in New South Wales, is the great centre of silver production in Australia.

(i) *New South Wales.* (a) *Broken Hill.* A description of the silver-bearing area in this district is given in earlier issues of the Year Book. During 1913 the output of ore from the mines in this division amounted to 1,744,000 tons, the highest recorded in the history of the field, but owing to the dislocation caused by the war the quantity raised in 1914 decreased to 1,442,000 tons. For the four years 1915 to 1918 the ore raised averaged over 1,200,000 tons, but, owing to the cessation of operations through industrial troubles and the fall in the price of metals the production in 1919 dwindled to 415,400 tons, and in 1920, when operations were carried on for a few weeks only, to 38,661 tons. In 1921 the output rose to 317,333 tons, in 1922 to 640,064 tons, and in 1923 to 878,537 tons, of which 861,853 tons were sulphide and 16,684 tons oxidized ore.

Although the returns are not complete in all cases, the following table relating to the companies controlling the principal mines at Broken Hill will give some idea of the richness of the field :—

SILVER.—BROKEN HILL RETURNS TO END OF 1923.

Mine.	Value of Output to end of 1923.	Dividends and Bonuses Paid to end of 1923.
	£	£
Broken Hill Proprietary Co. Ltd.	49,893,733	12,456,550
Broken Hill Proprietary Block 14 Co. Ltd.	3,957,148	632,160
British Australian Broken Hill Co. Ltd.	5,858,998	821,280
Broken Hill Proprietary Block 10 Co. Ltd.	4,946,989	1,432,500
Sulphide Corporation Ltd. (Central Mine)	22,543,588	2,926,875
Broken Hill South Ltd.	13,257,847	2,935,000
North Broken Hill Ltd.	7,895,584	2,288,940
Broken Hill Junction Lead Mining Co.	1,185,058	87,500
Junction North Broken Hill Mine	2,687,774	160,814
The Zinc Corporation Ltd.	3,442,466	10,000
Barrier South Ltd.	151,517	50,000
Totals	115,820,702	23,801,619

The returns relating to dividends and bonuses paid are exclusive of £1,744,000 representing the nominal value of shares in Block 14, British, and Block 10 companies, allotted to shareholders of Broken Hill Proprietary Company. If the output of the companies engaged in treating the tailings, etc., be taken into consideration, the totals for output and dividends shown in the table would be increased to about 123 millions and 28 millions respectively. The authorized capital of the various companies amounted to £8,148,000.

(*b*) *Picton Division.* The mines in the Yerranderie area produced 5,151 tons of ore in 1923, yielding 575,491 ozs. of silver, besides 928 ozs. of gold and 1,662 tons of lead, the total production being valued at £123,917, the highest yet recorded. Of the total production in 1923, 3,500 tons valued at £84,000 were raised by the Silver Peaks Mines. Parts of one of the stopes in this mine showed over 10 feet of solid galena, yielding 120 ozs. of silver, and 33 per cent. of lead per ton. Ore to the value of £35,000 also was raised by the Colon Peaks Mining Co. in this area.

(*c*) *Yass Division.* During 1923 the Kangiara mine produced 125 tons of ore yielding 3,325 ozs. of silver, 45 tons of lead, and 13 ozs. of gold. About 470 ozs. of silver, and 8 ozs. of gold were also obtained from copper ores.

(*d*) *Other Areas.* Small quantities of silver, lead, gold, and copper were produced during the year in the Condobolin, Tingha, Tumbarumba, and Wilson's Downfall Divisions.

(ii) *Victoria.* The silver produced in 1923 amounted to 6,304 ozs., valued at £963, and was obtained in the refining of gold at the Melbourne Mint.

(iii) *Queensland.* The yields from the chief silver and lead producing centres in 1923 were as follows :—Chillagoe, silver £56,308, lead £135,093 ; Herberton, silver £3,689, lead £2,606 ; Brisbane, silver £2,574, lead £3,566 ; Mt. Morgan, silver £2,389 ; Etheridge, silver £1,229, lead £3,293. Some of the mining leases in the Chillagoe area are owned by the State. The Mount Isa silver-lead field in the Cloncurry district was discovered in 1923, and the lodes so far opened are distributed over a length of 5 miles by a width of one mile along the west bank of the West Leichhardt River. Large accumulations of high grade carbonate of lead are in sight on this field, which, according to experts, is the largest find in importance since the discovery of Broken Hill.

(iv) *South Australia.* Rich specimens of silver ore have been discovered at Miltalie and Poonana, in the Franklin Harbour district, also at Mount Malvern and Olivaster, near Rapid Bay, and in the vicinity of Blinman and Farina. The surrounding district is also highly mineralized, but, so far, has not been thoroughly prospected. Attention has recently been devoted to the silver-lead ores at Eukaby, near Baratta. In 1923 a discovery of silver-lead ore was made between Ooloo Dam and Mount Distance, north of the Flinders Range, but operations of any magnitude thereat are at present unlikely. The production of silver in 1923 was valued at £60.

(v) *Western Australia.* The quantity of silver obtained as a by-product and exported in 1923 was 109,005 ozs., valued at £16,036. In addition, 20 tons of pig lead, valued at £609, were exported, together with 3,172 tons of lead and silver-lead ore and concentrates valued at £43,416. The production of lead ore from the Northampton mineral field amounted in 1923 to 21,635 tons.

(vi) *Tasmania.* The silver produced in 1923 amounted to 638,601 ozs., valued at £91,339, and the lead to 4,784 tons, valued at £127,542. Of the silver, Magnet Mines returned 165,078 ozs. ; North Mt. Farrell, 187,346 ozs. ; Zeehan Mines, 132,738 ozs. ; Mt. Lyell, 122,528 ozs. ; and Round Hill, 26,875 ozs. The principal producers of lead were North Mt. Farrell, 1,927 tons ; Zeehan Mines, 1,188 tons ; and Magnet Mines, 1,336 tons.

(vii) *Northern Territory.* Silver-lead ores are found near Pine Creek, and at Mount Shoebridge near Brock's Creek railway station. There are a number of fair-sized galena lodes in the Pine Creek and McArthur River districts, but owing to costs of transport and realization little attention is devoted to them. No production of silver-lead ores was recorded in 1923.

4. **World's Production.**—The world's production of silver during the last five years for which particulars are available is estimated to have been as follows :—

SILVER.—WORLD'S PRODUCTION, 1919 TO 1923.

Total.	1919.	1920.	1921.	1922.	1923.
World's production in 1,000 fine ozs.	176,457	174,612	171,284	213,541	240,058

The share of Australia in the world's silver production in 1919 was estimated at 7,800,000 ozs., or about 4½ per cent. on the total production, but in 1921, owing to the cessation of operations at the Broken Hill field, the total local extraction fell to 4,573,000 ozs., and the estimated silver contents of the ores, bullion, and concentrates exported to 732,000 ozs., the total being a little over 3 per cent. on the world's production. For 1923 the local extraction was set down as 7,646,000 ozs., and the contents of concentrates, etc., exported 5,110,000 ozs., the total representing about 5 per cent. on the world's production. The figures for the world's production are given on the authority of *The Mineral Industry.*

Arranged in order of importance the estimated yields in 1923 from the chief silver-producing countries were as follows :—

SILVER.—PRODUCTION, CHIEF COUNTRIES, 1923.

Country.	Production.	Country.	Production.
	Fine ozs. ('000 omitted.)		Fine ozs. ('000 omitted.)
Mexico	90,810	Japan	3,500
United States	73,335	Central America ..	2,000
South America	23,000	East Indies	1,200
Canada	17,754	Transvaal	1,200
Australia	12,756	Rhodesia	170
Europe	11,000	China	60
British India	5,000	Congo	30

5. **Prices.**—As the production of silver is dependent to a very large extent on the price realized, a statement of the average price per standard ounce in the London market during the last five years is given below :—

SILVER.—PRICES, 1919 TO 1923.

Price.	1919.	1920.	1921.	1922.	1923.
Pence per standard oz... ..	57.08	61.59	36.89	34.41	31.93

Prices in 1919 showed a sensational rise. Beginning with an average of about 48⅜d. per ounce during each of the first four months of the year, prices rose rapidly until in September the high average of 61.7d. was reached, followed by 64d. in October, 70d. in November, and 76.4d. in December. In January, 1920, the price rose to 79.8d., and in February the record figure of 85d. per oz. was reached. Next month, however, there was a drop to a little over 74d., and from August, when the price was 59.87d., the quotations fell rapidly, the figure in December being 41.85d. The average for January, 1921, was about 40d., but by the end of June the price had fallen to less than 35d., followed by a rise to 41 7/16d. in October, and again declining to 35⅝d. at the end of the year. In March, 1922, the price fell to 33¼d., and in September the average stood at 35 5/16d., but thenceforward there was a rapid decline, the price for the closing month of the year being 31⅜d. There were no violent fluctuations in 1923, the lowest figure being 30.88d. in February, and the highest 33.38d. in December. The average for the year, 31.93d. was the lowest since 1916, when the figure was 31.32d.

6. **Employment in Silver Mining.**—The number of persons employed in silver mining during each of the last five years is given below :—

SILVER MINING.—PERSONS EMPLOYED, 1919 TO 1923.

Year.	N.S.W.	Q'land.	W. Aust.	Tasmania.	Nor. Ter.	Australia.
	No.	No.	No.	No.	No.	No.
1919	6,556	145	(a) 74	798	3	7,576
1920	1,931	143	(a) 238	517	2	2,831
1921	3,150	229	(a) 41	352	..	3,772
1922	4,712	321	(a) 152	495	..	(b)5,686
1923	5,155	133	(a) 96	510	..	5,894

(a) Lead ore. (b) Including 6 in South Australia.

The bulk of the employment was in New South Wales and Tasmania, the quantity of silver raised in the other States, excepting Queensland, being unimportant. The closing of the mines on the Broken Hill field during the greater part of the year was responsible for the falling-off in the total for 1920, while the resumption of normal activity in 1921 was delayed by the causes alluded to in 2 hereinbefore.

§ 5. Copper.

1. **Production.**—The production of copper in the various States has been influenced considerably by the ruling prices, which have undergone extraordinary fluctuations. The quantity and value of the local production as reported and credited to the mineral industry for the years 1919 to 1923 are shown in the following table :—

COPPER.—PRODUCTION, 1919 TO 1923.

State.		1919.	1920.	1921.	1922.	1923.
QUANTITY.						
		Tons.	Tons.	Tons.	Tons.	Tons.
New South Wales	Ingot and Matte	1,460	1,290	499	575	1,182
	Ore	..	..	..	50	79
Queensland	Ingot and Matte	9,997	15,897	2,428	5,104	6,243
	Ore	..	..	..	..	..
South Australia	Ingot and Matte	2,517	4,339	1,532	1,185	3,523
	Ore	..	..	..	..	..
Western Australia	Ingot and Matte	4	137	206	660	1,057
	Ore	455	1,511	1,040	352	3,394
Tasmania	Ingot and Matte	5,071	4,792	6,181	5,616	6,065
	Ore	..	..	..	..	..
Northern Territory	Ingot and Matte	..	..	..	..	..
	Ore	(a) 159	(a) 67	..	(a) 58	..
VALUE.						
		£	£	£	£	£
New South Wales		139,296	127,978	41,267	36,233	82,375
Queensland		952,501	1,551,995	168,556	321,535	430,746
South Australia		228,930	423,601	106,370	73,646	232,172
Western Australia		10,105	25,165	24,601	20,379	65,100
Tasmania		558,694	528,237	463,163	391,535	435,413
Northern Territory ..		(a) 2,349	(a) 780	..	798	30
Australia		1,891,875	2,657,756	803,957	844,126	1,245,836

(a) Year ended 30th June.

The heavy fall during 1921 was due to the low price of the metal preventing the profitable working of many of the copper mines throughout Australia, and the continuation of low prices had a depressing effect on production in 1922 and 1923.

2. **Sources of Production.**—(i) *New South Wales.* Production in this State in 1932 was valued at £82,375, as compared with £36,233 in the preceding year, the increase being due to the extraction of the small copper content in the Broken Hill silver-lead and zinc ore, about 899 tons of copper, valued at £61,761 being obtained from this source. The depression in this branch of the mining industry in 1922 was again accentuated by the low prices ruling for copper in 1923, coupled with the high cost of production and transport. No ore was raised in the Cobar division, which a few years ago was the largest producer of copper in the State, and the expensive machinery at the Great Cobar, Chesney, and Cobar Gold Mines, has been dismantled and removed.

The Tottenham division produced about 1,600 tons of ore during the year, and small quantities were raised in the Orange and Yass divisions. In the Canbelego division about 1,000 tons of 5 per cent. ore were raised for fluxing purposes, and 600 tons raised in the Molong division were used for converter lining.

(ii) *Queensland.* The yield in this State amounted in 1923 to 6,242 tons valued at £430,746, and shows a serious decline as compared with 1920 when nearly 16,000 tons valued at £1,552,000 were raised. The falling-off in the yield in recent years was, of course, due to the low prices realized for copper. Returns from the chief producing areas in 1923 were as follows:—Mount Morgan, 4,848 tons, valued at £334,495; Herberton, 155 tons, £10,730; Cloncurry, 518 tons, £35,776; and Chillagoe, 651 tons, £44,940. These yields naturally compare very unfavourably with those of 1920. The Cloncurry district—reckoned the richest and most extensive cupriferous area in Australia—which under normal circumstances produces more than half the copper output of the State, returned a yield of 518 tons, as against 7,640 tons in 1920.

(iii) *South Australia.* Taking the entire period over which production extended, the yield of copper in South Australia easily outstrips that of any other State. In recent years, however, Queensland, Tasmania, and New South Wales have come to the front as copper producers, as the table on the preceding page shows. Deposits of copper ore are found over a large portion of South Australia. A short account of the discovery, etc., of some of the principal mining areas, such as Kapunda, Burra Burra, Wallaroo, and Moonta, was given in earlier issues of the Official Year Book. During 1922 the output amounted to 1,185 tons, valued at £73,646, the lowest recorded since 1844. The decline was due to the closing down during the greater part of the year of the Wallaroo and Moonta mines. In 1923 the production amounted to 3,523 tons, valued at £232,172. Wallaroo and Moonta carried on mining and smelting during the first six months of the year, but the continued low price of copper led to a final closing down. It is stated that the low price is partly due to heavy production by companies in America, who, working with the latest appliances on immense deposits, can operate at a profit even with existing selling rates.

(iv) *Western Australia.* The value of copper and ore exported from this State in 1923 was £65,100. According to the returns, the production in the West Pilbara field was 221 tons, valued at £3,500; in the Northampton field, 9,629 tons, valued at £59,143; while the Phillips River field showed a production of 26 tons, valued at £541. The Whim Well mine on the Pilbara field was the principal producer, but operations were greatly restricted by the low price ruling for the metal.

(v) *Tasmania.* The quantity of copper produced in Tasmania during 1923 was 6,065 tons, valued at £435,413, practically the whole of the production being due to the Mount Lyell Mining and Railway Co. Ltd. This Company treated 48,394 tons of ore and concentrates and produced 6,104 tons of blister copper, containing copper, 6,052 tons; silver, 122,527 ozs.; and gold, 1,996 ozs.; the whole being valued at £460,598. The employees in 1923 numbered 1,059, of whom 536 were miners, 394 were engaged in the reduction works, and 129 in the railway department. Current for power and lighting is obtained from the Lake Margaret hydro-electric plant. To the end of 1923 this Company had paid upwards of £4,023,000 in dividends.

(vi) *Northern Territory.* Copper has been found at various places, but lack of capital and difficulty of transport prevent the development of the deposits. During 1923, about 4 tons of ore were raised from a deposit near the Kilgour River, about 80 miles from Borroloola.

3. **Prices.**—The great variation in price that the metal has undergone is shown in the following table, which gives the average price in London and New York during each of the last five years. The figures are given on the authority of the *The Mineral Industry.*

COPPER.—PRICES, 1919 TO 1923.

Year.	London Price per Ton Standard Copper.	New York Price in Cents per lb. Electrolytic Copper.
	£	Cents.
1919	90.80	18.69
1920	97.48	17.46
1921	69.36	12.50
1922	62.12	13.38
1923	65.84	14.42

As evidence of the tremendous monthly variation in the price of copper it may be noted that in December, 1916, the average London price of standard copper was £145 6s. 4d. per ton, while in April, 1922, it was quoted at £58 16s.

4. **World's Production of Copper.**—The world's production of copper during the five years 1919 to 1923, is estimated to have been as follows :—

COPPER.—WORLD'S PRODUCTION, 1919 TO 1923.

Year	1919.	1920.	1921.	1922.	1923.
World's production—tons ..	977,500	933,600	544,200	854,100	1,245,500

The yields from the chief copper-producing countries in 1923 were as follows :—

COPPER.—PRODUCTION, CHIEF COUNTRIES, 1923.

Country.	Production.	Country.	Production.
	Tons.		Tons.
United States	640,500	Canada	35,900
Chile	200,000	Australia	18,600
Africa	72,700	Germany	16,700
Japan	62,800	Cuba	10,700
Mexico	54,000	Bolivia	10,500
Spain and Portugal ..	51,000	Norway	7,900
Peru	43,100	Serbia	6,700

The Australian production in 1923 amounted to about 1.5 per cent. of the total.

5. **Employment in Copper Mining.**—The number of persons employed in copper mining during each of the last five years was as follows :—

COPPER MINING.—PERSONS EMPLOYED, 1919 TO 1923.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.	Australia.
	No.	No.	No.	No.	No.	No.	No.	No.
1919 ..	1,148	..	2,521	400	72	1,571	12	5,724
1920 ..	583	2	1,815	1,285	116	1,577	2	5,380
1921 ..	109	..	675	1,000	36	1,361	6	3,187
1922 ..	66	..	882	70	10	948	6	1,982
1923 ..	85	..	1,176	420	80	1,066	3	2,830

§ 6. Tin.

1. **Production.**—The development of tin mining is, of course, largely dependent on the price realized for the metal, and, as in the case of copper, the production has been subjected to somewhat violent fluctuations. The tables below show the quantity and value of the production as reported to the Mines Departments in each of the States during the five years, 1919 to 1923 :—

TIN.—PRODUCTION, 1919 TO 1923.

State.		1919.	1920.	1921.	1922.	1923.
		QUANTITY.				
		Tons.	Tons.	Tons.	Tons.	Tons.
New South Wales ..	Ingots	1,146	(e)887	(e)816	734	896
	Ore	1,546	2,486	1,595	410	..
Victoria	Ingots	..	..	..	..	..
	Ore	113	84	80	115	78
Queensland	Ingots	(b)	(b)	(b)	(b)	(b)
	Ore(a)	994	1,486	1,050	1,098	903
Western Australia ..	Ingots	..	..	..	..	..
	Ore	318	243	67	110	131
Tasmania	Ingots	1,580	1,310	790	679	1,160
	Ore	(c)	(c)	..	..	..
Northern Territory ..	Ore	(d)162	(d)180	(d) 83	(d)79	(d)136
		VALUE.				
		£	£	£	£	£
New South Wales		416,623	413,794	163,451	154,698	180,789
Victoria		17,561	12,815	11,961	12,071	10,371
Queensland		143,167	252,054	98,471	99,758	114,945
Western Australia		47,269	49,449	6,485	10,930	15,095
Tasmania		395,794	369,362	130,257	112,407	236,955
Northern Territory		(d)30,021	(d)27,610	(d)7,793	5,891	13,887
Total		1,050,435	1,125,084	418,418	395,755	572,042

(a) Dressed tin ore, about 70 % tin. (b) Included with ore. (c) Included with ingots. (d) Year ending 30th June.

As the table shows, there was a further decline in the production of tin in 1922, the values being the lowest recorded for the quinquennium. The falling-off was due to low prices and high production costs, and in some instances to exhaustion of ore supplies. Dredging operations in certain districts were hampered by insufficiency of water. In New South Wales there was again a reduced output from dredging in the New England district.

2. **Sources of Production.**—(i) *New South Wales.* Tin-mining operations were stimulated by the increased price of the metal in 1923, but the yield from the New England district, which is the principal producing area, was adversely affected by the exceptionally dry season. A large proportion of the output in New South Wales is obtained by dredging, the quantity so won in 1923 being 522 tons, valued at £72,552. Forty-one pump-dredges and one bucket dredge were in operation during the year. In the Tingha division of the Peel and Uralla district the yield amounted to 400 tons, valued at £49,922. The Emmaville division in the New England district showed a yield of 365 tons, valued at £47,892. The Vegetable Creek mine in this area was, for many years, the chief producer of tin in the State, but the payable wash available was practically exhausted in 1921. Operations were terminated in 1923, and the hopperings left were treated by tributors or miners. In the Wilson's Downfall division, 62 tons, valued at £7,959, were raised. From the Torrington division, 160 tons, valued at £20,117, were returned. The Ardlethan field, in the Lachlan division, produced ore and concentrates to the value of £18,242.

(ii) *Victoria.* The bulk of the production in 1923 was obtained by dredging and sluicing, the Cock's Pioneer Gold and Tin Co. in the Beechworth district contributing 77 tons, valued at £10,344. A small quantity of tin ore was raised by the Victorian Tin mines at Eskdale.

(iii) *Queensland.* The chief producing districts in Queensland during 1923 were Herberton, 529 tons, valued at £58,655; Kangaroo Hills, 124 tons, £24,868; Stanthorpe, 113 tons, £14,553; Cooktown, 75 tons, £9,213; Chillagoe, 45 tons, £5,637. The low prices of the metal in 1922 had a depressing effect on the industry, the production for the year being valued at £99,758 as compared with £252,000 in 1920. Prices improved towards the end of 1922 and the further increase in 1923 led to renewed activity, particularly on the Herberton and Kangaroo Hills fields.

(iv) *Western Australia.* The export of tin ore for the State during 1923 amounted to 131 tons, valued at £15,095. The production of black tin from the Greenbushes field amounted to 28 tons, valued at £3,024, and from the Pilbara field 24 tons, valued at £2,960. Deposits of tin occur in widely-separated localities in the Kimberley division, the Thomas River in the Gascoyne Valley, and at Poona and Coodardie on the Murchison gold-field.

(v) *Tasmania.* During 1923 the quantity of metallic tin won amounted to 1,160 tons, valued at £236,955. This return is a considerable advance on the figures for the two preceding years, but is still far below that recorded in 1919 and 1920. The yield from the North-Eastern division amounted in 1923 to 651 tons. Of the total, 309 tons were contributed by the mines in the Pioneer and Gladstone districts, while 338 tons came from the Ringarooma, Derby, and Branxholm area. The yield in the Eastern division amounted to 216 tons; the Avoca Mines furnishing 117 tons; the St. Helen's Mines 54 tons; and the Weldborough, Lottah, and Blue Tier, 45 tons. From the North-Western division the output was 247 tons, the bulk of it being raised by the Mt. Bischoff, with 194 tons, and Mt. Bischoff Extended, with 45 tons. The production in the Western division was returned at 46 tons.

(vi) *Northern Territory.* The yield of tin ore in 1923 amounted to 136 tons, valued at £13,887, of which 53 tons were raised at Marranboy. Stanniferous deposits are found at various places, including Marranboy, Hayes Creek, Mt. Wells, Wolfram Camp, Mary River, Horseshoe Creek, Bynoe Harbour, Umbrawarra, Pine Creek, and Mt. Ringwood. Two batteries for the treatment of tin ore have been erected by the Government, one at Marranboy, costing £20,163, and one at Hayes Creek, at an expense of £3,294.

3. World's Production.—According to *The Mineral Industry* the world's production of tin during each of the last five years was as follows. The figures have been slightly amended since last issue.

TIN.—WORLD'S PRODUCTION, 1919 TO 1923.

1919.	1920.	1921.	1922.	1923.
Tons.	Tons.	Tons.	Tons.	Tons.
119,465	120,713	99,728	130,660	127,391

The yields from the chief producing countries in 1923 were as follows:—

TIN.—PRODUCTION, CHIEF COUNTRIES, 1923.

Country.	Production.	Country.	Production.
	Tons.		Tons.
Federated Malay States ..	37,600	Nigeria	5,900
Bolivia	29,800	Australia	2,200
Billiton	15,600	Unfederated Malay States	2,000
Banka	15,400	India	1,300
China	8,700	South Africa	850
Siam	6,300	Cornwall	700

Based on the results for the last three years, Australia's share of the world's tin production would appear to be about 2.2 per cent.

4. Prices.—The average price of the metal in the London market for the years 1919 to 1923 was as follows :—

TIN.—PRICES, 1919 TO 1923.

Year.	Price per Ton.			Year.	Price per Ton.		
	£	s.	d.		£	s.	d.
1919	257	9	8	1922	159	9	0
1920	296	1	7	1923	202	5	0
1921	165	5	4				

The year 1921 was a disastrous one for the tin miner, as the price of the metal dropped by over £130 per ton as compared with that in the preceding year. Moreover, the fall had been more or less continuous since the early months of 1920, thus forcing the poorer mines to close down. In Malaya, the alluvial miners tried to carry on by working for low wages, and, in some cases, for no return, but the depression proved longer than was expected, and it is stated by *The Mineral Industry* that the necessity for picking the eyes of mines has in some measure depleted the world's reserves of stanniferous ground. The depressing influence of the stocks held in the East also adversely affected the market. Coupled with this was the low level of consumption, the Continental demand being poor, while the industry in Great Britain was hampered by the coal strike, and imports into the United States were far below the average. In 1922, the London market opened at £168 15s., but fell to £139 in March. Thereafter prices generally improved to £183 15s. at the close of the year. Conditions greatly improved in 1923. The price in January averaged £181 18s. 7d. rising to £219 15s. in March, but there was a drop to £181 5s. 3d. in July. Thereafter the figures rose steadily until December when £235 2s. 3d. was realized, while the average for the year stood at £202 5s.

5. Employment in Tin Mining.—The number of persons employed in tin mining during the last five years is shown below :—

TIN MINING.—PERSONS EMPLOYED, 1919 TO 1923.

Year.	N.S.W.	Victoria.	Q'land.	W. Aust.	Tas.	Nor. Ter.	Australia.
	No.	No.	No.	No.	No.	No.	No.
1919	2,171	38	1,114	209	1,303	190	5,025
1920	1,822	48	920	187	1,318	120	4,415
1921	1,321	31	864	59	699	100	3,074
1922	1,090	13	659	31	620	120	2,533
1923	1,047	7	703	35	842	170	2,804

Most of the tin in Victoria is produced by companies mining primarily for gold.

§ 7. Zinc.

1. Production.—(i) *New South Wales.* (*a*) *Values Assigned.* The production of zinciferous concentrates is practically confined to the Broken Hill district of New South Wales, where zincblende forms one of the chief constituents in the enormous deposits of sulphide ores. During the earlier years of mining activity on this field a considerable amount of zinc was left unrecovered in tailings, but from 1909 onwards improved methods of treatment resulted in the profitable extraction of the zinc contents of the accumulations at the various mines.

As the metallic contents of the bulk of the concentrates, etc., raised in the Broken Hill District are extracted outside New South Wales, the mineral industry of that State is not credited by the Mines Department with the value of the finished product. The

figures given hereunder, therefore, refer to the quantity and value of the zinc concentrates actually exported during the years specified.

ZINC.—CONCENTRATES, ETC., EXPORTED FROM NEW SOUTH WALES, 1889 TO 1923

Year.	Quantity of Zinc Concentrates, etc. Exported.	Value.	Year.	Quantity of Zinc Concentrates, etc., Exported.	Value.
	Tons.	£		Tons.	£
1889	97	988	1920	71,043	249,456
1891	219	2,622	1921	79,694	283,455
1899	49,879	49,207	1922	363,681	1,157,458
1919	72,294	247,395	1923	426,049	1,411,652

(b) *Local and Foreign Extraction.* A statement of the quantity of zinc extracted in Australia and the estimated zinc contents of concentrates exported overseas during the five years 1919 to 1923, will be found in § 18 hereinafter.

(ii) *Queensland.* At the Silver Spur mine at Texas, in the Stanthorpe division of Queensland, part of the ore is high in zinc and lead, but low in silver. Profitable extraction of the zinc and lead depends, however, on cheap transport. It is proposed to convey the high grade zinc ore by motor tractor to the railway at Inglewood. Zinc sulphide is produced by the Mount Garnet Mine in the Herberton district, and during 1916 several hundred tons of good quality ore were raised, but until a suitable treatment plant has been erected, it is stated that production cannot be economically undertaken.

(iii) *South Australia.* Zinc is known to exist in various localities in South Australia, but there has been no production during recent years.

(iv) *Other States.* During the year 1916, a small quantity of zinc, valued at £630, was produced in Western Australia, but there was no production recorded for subsequent years. The Tasmanian mineral returns for 1920 included an item of 9 tons of zinc ore, valued at £334, raised at the Swansea Mine, near Zeehan, but none was recorded for the last three years.

Investigations in regard to the Read-Roseberry zinc-lead deposits in Tasmania have proved the existence of 1,680,000 tons of ore, which, added to an estimated quantity of 915,000 tons of "probable" ore, make a total supply of 2,595,000 tons. It is stated that the metallurgical treatment of the ore can be successfully carried out, and that the deposits are amongst the richest and most important in the world.

The Electrolytic Zinc Co. at Risdon continued the treatment of calcines from Broken Hill, and during 1923 produced 41,153 tons of slab zinc, valued at £1,328,615. Silver-lead residues produced for shipment to Port Pirie contained 6,557 tons of lead and 917,425 ozs. of silver. The cadmium plant produced 123 tons of cadmium, valued at £34,776. About 1,282 men were employed at these works.

2. **Prices.**—During the four years 1911 to 1914, the London price of zinc averaged £23 15s. per ton, ranging from £21 in 1914 to £26 3s. 4d. in 1912. Owing to the heavy demand and other circumstances arising out of the war, the prices in 1915 and 1916 reached the very high average of £67 11s. 1d. and £72 1s. 5d. per ton respectively. For 1917 the average recorded was £52 8s. 3d., for 1918, £54 3s. 7d., for 1919, £42 17s. 7d., for 1920, £44 7s. 5d., for 1921, £25 16s. 11d., for 1922, £30, and for 1923, £33 1s. 2d. per ton.

§ 8. Iron.

1. **General.**—The fact that iron-ore is widely distributed in Australia has long been known, and extensive deposits have been discovered from time to time at various places throughout the States. It will appear, however, from what is stated below, that the utilization of these deposits for the production of iron and steel is, at present, confined to New South Wales.

2. **Production.**—(i) *New South Wales.* (a) *Extent of Deposits.* Iron ores of various composition are found widely distributed throughout the State, but some of the deposits are at present of no commercial importance on account of their small and scattered extent, or by reason of their distance from means of transport. Excluding deposits

too far from existing railways, or too small to warrant exploitation, as well as aluminous ores, the quantity of iron ore available by quarrying has been set down as 15 million tons. There is, in addition, a large tonnage available by the more costly method of mining. Altogether it appears probable that the total quantity available for smelting is about 53 million tons. The chief sources of supply during recent years were the deposits at Cadia, Carcoar, and Tallawang.

(*b*) *Lithgow Iron Works.* Reference to the events leading up to the establishment of ironworks at Lithgow will be found in earlier issues of the Year Book (see No. 3. p. 508). During 1923 the following materials were received at the blast furnaces: Iron ore, 173,507 tons; limestone, 86,985 tons; slag, 6,320 tons; and coke, 142,719 tons. The iron ore was raised from quarries at Tallawang, Cadia, Coombing Park, and Breadalbane, and the pig iron produced therefrom amounted to 94,350 tons.

The following table shows the quantity and value of pig iron produced in New South Wales during the last five years from locally-raised ores only :—

PIG IRON.—PRODUCTION FROM LOCAL ORES, NEW SOUTH WALES, 1919 TO 1923.

Particulars.		1919.	1920.	1921.	1922.	1923.
Quantity ..	Tons	80,941	86,096	90,053	54,856	94,350
Value	£	445,175	645,720	639,376	248,909	707,625

The figures quoted above refer to production from *local* ores only, and as such credited to the New South Wales mineral industry. They do not, of course, represent the total production of pig iron in New South Wales, since, as shown in the succeeding paragraph, a considerable quantity of ore raised in South Australia and credited therefore to the mineral returns of that State is treated in New South Wales.

(*c*) *Newcastle Iron Works.* The Broken Hill Proprietary Company established works for the manufacture of iron and steel on a large scale at Newcastle, and operations were started early in 1915. The Company is utilizing the immense deposit of iron ore at the Iron Knob quarries in South Australia, which are connected with the seaboard at Whyalla, a distance of about 34 miles, by the Company's tramway. The ore quarried for the year ended 30th November, 1924, amounted to 568,691 tons. Extensive limestone works and loading bin at Devonport, Tasmania, as well as quarries in New South Wales for dolomite, magnesite, etc., are also owned by the Company.

The output of pig iron for the year ended 30th November, 1924, amounted to 327,809 tons, and of steel ingots to 302,384 tons. Further details in regard to the activities of these works in 1921 were given on page 347 of Official Year Book No. 15. The steel works possess three blast furnaces of a normal daily producing capacity of 1,300 tons, and a fourth furnace of 100 tons for the production of foundry iron. There are seven 65-ton basic open-hearth furnaces capable of producing 8 to 10,000 tons of ingot steel weekly, and 2 additional 65-ton open hearth furnaces are nearing completion. The works are supplied with a 35-inch blooming mill for the production of blooms, plates, etc., a 28-inch rolling mill for the manufacture of heavy rails, structural steel, billets, etc., an 18-inch mill for making light rails, structural shapes, fishplates, and heavy sections of merchant bar and billets, a 12-inch mill and an 8-inch mill, each for merchant bars, etc., a continuous rod mill for the production of wire rods, and a fishplate mill. A steel foundry, containing one acid open-hearth furnace, and a cupola furnace for iron castings, with a direct metal foundry which takes the hot metal from the blast furnaces, supply all necessary castings.

The Company also possesses 224 by-product coke ovens, and connected with this department are the tar, sulphate of ammonia, and benzol plants.

(*d*) *Iron Oxide, etc.* A quantity of iron oxide is purchased by the various gasworks for use in purifying gas, and it is also to some extent employed as a pigment, the output in New South Wales being drawn chiefly from the deposits in the Port Macquarie, Moss Vale and Yass Divisions. During 1923 the iron oxide raised amounted to 2,716 tons, valued at £3,081, the product being partly used for the manufacture of pigments, and partly by gas companies for purifying purposes.

(ii) *Victoria.* Iron ore has been located at various places in Victoria, particularly at Nowa Nowa in the Gippsland district, and at Dookie. A blast furnace was erected in 1881 near Lal Lal, on the Moorabool River, and some very fair quality iron was produced, which was used for truck wheels and stamper shoes at the Ballarat mines. The fall in the price of the metal, however, led to the closing of the works. In his report for 1905 the Secretary for Mines stated that without special assistance to the industry there does not seem to be any prospect of the deposits being profitably worked.

(iii) *Queensland.* Queensland possesses some extensive deposits of iron ore, which are mined chiefly for fluxing purposes in connexion with the reduction of gold and copper ores. During the year 1921, 4,061 tons of ironstone flux, valued at £5,976, were raised, the bulk of which came from Iron Island in the Rockhampton district. No production was recorded in 1922, and 200 tons only, valued at £150, were raised in 1923. It is stated that Queensland possesses within its own borders an abundance of the ore, fuel, and fluxes required for the carrying on of a large ironworks. The important lodes on the Wild River are a promising source of supply for the proposed State iron and steel works.

(iv) *South Australia.* South Australia possesses some rich deposits of iron ore capable of being mined for an indefinite period. The best known deposit is the Iron Knob, a veritable hill of iron ore of high percentage, situated about 40 miles W.S.W. from Port Augusta. A recent survey places the probable reserves of ore in the Iron Knob and Iron Monarch deposits at 133 million tons, with an average content of 63.64 per cent iron. The Broken Hill company utilizes ore from this quarry at its ironworks at Newcastle, New South Wales, and the amount raised for the year 1921 was 506,993 tons, valued at £587,267, and for 1922, 51,423 tons, valued at £58,177, the heavy fall in the latter year being due to the temporary closing of the works. Owing to resumption of activity in 1923 the production for the year rose to 384,434 tons, valued at £445,303. It is estimated that the deposits in the Middleback Range contain 32 million tons of slightly higher grade than the Iron Knob ore.

(v) *Western Australia.* This State has some very rich deposits of iron ore, but owing to their geographical position, the most extensive fields at the present time are practically unexploited, the production in the State being confined chiefly to that needed for fluxing purposes. The ores are found over a stretch of country from Kimberley to Cape Leeuwin. Amongst the most important of the high-grade deposits are those at Yampi Sound in the Kimberley division, which are estimated to contain 97 million tons of very rich ore; Wilgie Mia, where the ore in sight is estimated at 27 million tons; Gabanintha, near Nannine, with over a million tons above surface level, Mount Gibson, in the south-west corner of the Yalgoo gold-field, where there are about 10 million tons of ore adapted for steel manufacture by the acid process; Tallering Range in the westernmost angle of the Yalgoo gold-field where the deposits amount to several millions of tons; and Koolyanobbing, near Southern Cross, where there is a very large deposit of high-grade micaceous hematite. The production of pyritic ore reported in 1922 amounted to 3,441 tons, valued at £4,203, but none was recorded in 1923.

(vi) *Tasmania.* Probably the most extensive deposits of iron ore in Tasmania are those at Rio Tinto, Savage River. The ore is chiefly magnetite, containing over 65 per cent. iron, and is well situated for open cutting to a great depth. Estimates place the quantity of ore available at as high as 50 million tons. There is an immense deposit of red hematite at the Blythe River, near Burnie, the lode being over a mile in length, and up to 100 feet in width. Estimates as to the quantity of ore available vary from 17 to 30 million tons. In fairly close proximity to the Hampshire Railway Station there is a deposit of magnetite estimated to contain 20 million tons, while a deposit at the Tenth Legion mine in the Zeehan district is stated to contain 2 million tons. Deposits of brown oxide and magnetic iron ore containing 1½ million tons are found in the Beaconsfield district. On the Dial Range there is a deposit of red hematite containing high grade ore. North-west of this outcrop is situated the Iron Cliffs lode, about 4 miles from Penguin. These two deposits are estimated to contain 700,000 tons. Extensive deposits of hematite and magnetite are found on the Nelson River, the outcrop being 100 feet wide over a large distance. The total quantity of iron ore available in Tasmania has been roughly estimated at 100 million tons.

The total production of iron ore in 1908 was 3,600 tons. valued at £1,600, all raised by the Tasmanian iron mine at Penguin, but since the closing down of that mine in 1909 there has been no further production. Iron pyrites for the manufacture of sulphuric acid and of manures is produced on the West Coast, the quantity raised in 1923 being 11,882 tons, valued at £26,737.

(It may be noted here that the Sulphur Bounty Act of 1923 provides for a bounty of £2 5s. per ton in respect of sulphur produced from Australian pyrites and other sulphide ores and concentrates.)

(vii) *Northern Territory.* Large bodies of rich ironstone have been discovered in various parts of the Territory, particularly between the Adelaide River and Rum Jungle. Owing to the lack of local coal, however, the deposits possess no immediate value.

3. **Iron and Steel Bounties.**—The local production of iron and steel has been encouraged by various legislative enactments (see Official Year Book No. 15, p. 348). Under "The Iron and Steel Products Bounty Act 1922," bounties are payable on fencing wire, galvanized sheets, wire-netting, and traction engines made in Australia. It is essential that these articles be made from materials produced and manufactured in Australia, unless imported material is authorized after enquiry and report by the Tariff Board. The total payments in any one financial year must not exceed £250,000. Rates of bounty are—for fencing wire and galvanized sheets, £2 12s. per ton for wire-netting, £3 8s. per ton; and for traction engines from £40 to £90 each, according to brake horse-power.

The Act of 1918 provided for bounty amounting to a total of £200,000 on black steel sheets and galvanized sheets produced in Australia under prescribed conditions up to the 30th September, 1923.

4. **World's Production of Iron and Steel.**—The Australian production of iron and steel at present forms a very small proportion of the world output. According to The Statesman's Year Book, the world's production of each commodity in the years specified for the principal countries was as follows :—

PIG IRON AND STEEL—WORLD'S PRODUCTION, 1913, and 1921 to 1923.

Country.	Pig Iron.				Steel—Ingots and Castings.			
	1913.	1921.	1922.	1923.	1913.	1921.	1922.	1923.
	(Tons—000's omitted.)				(Tons—000's omitted.)			
United States ..	30,653	16,506	26,851	39,500	31,301	19,744	35,603	44,400
Great Britain ..	10,260	2,616	4,902	7,360	7,664	3,703	5,881	8,480
France	5,126	3,308	5,147	5,000	4,614	3,010	4,464	4,750
Belgium ..	2,428	862	1,578	2,118	2,428	780	1,539	2,185
Luxemburg ..	..	955	1,650	1,350	..	747	1,368	1,117
Germany ..	19,000	6,096	8,000	4,000	18,631	8,700	9,000	5,000
Czecho-Slovakia ..	..	532	339	590	..	904	630	738
Poland	..	640	458	492	..	1,476	930	935
Japan	56	200	300	300	13	558	500	500
Other Countries ..	9,659	2,985	2,713	3,870	10,368	2,865	3,183	4,468
Total ..	77,182	34,700	51,938	64,580	75,019	42,487	63,098	72,573

The returns for the year 1923 have been partly estimated and are subject to revision when the complete particulars for all countries have been received.

§ 9. Other Metallic Minerals.

1. **Antimony.**—The production of antimony ore in New South Wales amounted in 1921 to 125 tons, valued at £900, the output being obtained in the Hillgrove and Kempsey divisions, but the low prices ruling in 1922 and 1923 caused a temporary cessation of mining. Deposits of the mineral are also found in the Glen Innes and Drake divisions, and in other areas. The total quantity of antimony (metal and ore) raised in New South Wales

up to the end of 1923 was 19,032 tons, valued at £344,588. The production of antimony concentrates in Victoria during 1923 amounted to 882 tons, valued at £14,112. The whole of the production came from ore raised by a company operating at Costerfield. In Queensland extensive deposits are found at Neerdie in the Wide Bay district, at Wolfram Camp, on the Hodgkinson field, on the Palmer River in the Ravenswood district, and at various places in the Herberton district. Ore has also been obtained in the Dividing Range near Herberton, and adjacent to some of the central tributaries of Emu Creek. A promising lode was recently discovered near Cooktown. Owing to the low price of the metal in 1919 production was practically negligible; while none was recorded during the period 1920 to 1923. In Western Australia lodes of stibnite carrying gold have been found in the Roeburne district. During 1917, 12 tons of antimony, valued at £258, were exported, but there was no subsequent production until 1920, when 3 tons, valued at £45, were exported. There was no record of production in the years 1921 to 1923.

2. **Arsenic.**—In New South Wales the production of arsenical ore in 1923 amounted to 11,493 tons, valued at £28,178, of which 7,655 tons were raised by the Valla Gold Mines in the Bellingen Division; 2,488 tons at the Ottery Mine in the Emmaville division; 417 tons in the Hillgrove Division; 300 tons in the Moruya Division; and 200 tons in the Torrington Division. Small quantities were also produced in the Deepwater and Tumut Divisions. During 1917 the high price ruling for arsenic, and the urgency for the need of supplies in connexion with the destruction of prickly pear, led to the reservation by the Queensland Mines Department of an extensive area of arsenic-bearing deposits at Jibbinbar, in the Stanthorpe district. Production in 1923 from the Stanthorpe district amounted to 610 tons, valued at £27,780, of which 340 tons valued at £19,040 were raised at the State mine. There is a strong demand for the product not only for the destruction of prickly pear, but for the manufacture of arsenical dip solutions and other purposes. In South Australia attention is being devoted to arsenic-bearing minerals at some of the old mines, and prospecting is being carried on at the Preamimma Mine and at Sedan. During 1920 Western Australia exported 1,765 tons of arsenical ore, valued at £4,260. In 1921 the export fell to 7 tons, valued at £16, but there was an increase to 1,075 tons, valued at £1,784, in 1922. The arsenical ore (contained in gold ore) exported in 1923 was valued at £686.

3. **Bismuth.**—Ores of this metal are found in association with tungsten and molybdenum, and sometimes tin, in New South Wales, but owing to lack of a market the production of ore and concentrates in 1923 was only 6 tons, valued at £1,640, of which 3 tons valued at £700 were obtained in the Torrington division. Ore was also raised in the Glen Innes, Oberon, Dalmorton, Pambula, and Tenterfield divisions, but only a small quantity was treated. The total production to the end of 1923 was 779 tons, valued at £226,419. In Queensland wolfram and bismuth have been found in various districts, but owing to the low prices obtainable the chief centres of production—Mount Carbine, Wolfram, Bamford, etc.—were practically idle in 1923. In South Australia deposits are found at Balhannah, at Mount Macdonald, and at Murninnie on the shores of Spencer's Gulf. A small quantity of bismuth was exported from Western Australia in 1919, but none was recorded subsequently. In Tasmania a small quantity, valued at £21, was raised in 1921 by the S. & M. mine at Middlesex, but there was no production in 1922 and 1923.

4. **Chromium.**—The output of chromite in New South Wales during 1923 was estimated at 1,192 tons, valued at £3,082, raised in the Barraba division. Prospecting operations were carried on during the year at Attunga in the Tamworth division. Chrome iron ore is found in Queensland in the Rockhampton district, and about 160 tons were raised in 1920 by the Mount Morgan Company at Glen Geddes, but there was no production during the last three years.

5. **Cobalt.**—This metal was found at Carcoar in New South Wales in 1889, and subsequently at Bungonia, Port Macquarie, and various other places. There was no export of cobalt since 1911, and the total produced since 1860 amounted in value to only a little over £10,000. In Queensland a rich deposit was opened up in 1920 at Mount Cobalt in the Cloncurry area, and the production in 1923 amounted to 217 tons, valued at £43,449. A discovery of the metal was made in 1923 at Redcap on the Chillagoe field. Although the product is a valuable one, greater development is hindered by the uncertainty of the demand.

6. **Lead.**—Lead mining *per se* is not practised to any extent in Australia, the supply of the metal being chiefly obtained in conjunction with silver. In New South Wales the Mines Department took credit in 1922 for 8,113 tons, valued at £194,712, and the production to the end of 1922 was taken as 327,000 tons, valued at £6,442,000. Owing to the closing down of the treatment works at Cockle Creek there was no production within the State in 1923, the whole of the lead concentrates being forwarded for treatment outside the State. As stated previously, the metallic contents of the major portion of the silver-lead ores are extracted outside New South Wales, and these figures refer only to lead values assigned as the produce of the State. In Victoria, oxides, sulphides, and carbonates of lead are found in the reefs on most of the goldfields. The deposits are not, however, of sufficient extent to repay the cost of working. In Queensland the deposits are worked chiefly for the silver, copper or gold contents of the ore, the lead produced in 1923 amounting to 5,487 tons, valued at £147,233. Of this total the Chillagoe area produced 5,038 tons, valued at £135,093; the Herberton area, 97 tons, valued at £2,606; Etheridge, 122 tons, £3,293; Brisbane, 129 tons, valued at £3,566; and the Cloncurry area 98 tons, valued at £2,628. Lead has been found at many places in South Australia, although, with few exceptions the lodes are not of great size. During 1923 pig lead exports from Western Australia amounted to 20 tons, valued at £609. Tasmanian lead production in 1923 was returned as 4,784 tons, valued at £127,542, of which the Zeehan mines contributed 1,188 tons, the North Mt. Farrell mines, 1,927 tons, Magnet, 1,336 tons, and Round Hill mines, 297 tons.

7. **Manganese.**—During 1923 the output of manganese ore in New South Wales amounted to 2,556 tons, valued at £7,748, practically the whole of the production being raised in the Grenfell division. A small quantity amounting to 40 tons, was produced in the Parkes division, and ore was raised but not sold in the Deepwater and Tamworth divisions. In Victoria the production in 1922 amounted to 150 tons, valued at £930, raised in the Heathcote division, but none was raised in 1923. In Queensland there are extensive deposits of low-grade manganese ores in various places. High grade ore is not available in quantity, but the extensive deposits of medium grade at Kandanga should in future become a valuable asset in the steel industry. Production in 1923 amounted to 74 tons, valued at £332, of which 40 tons were raised in the Stanthorpe division, and 30 tons in the Gympie division. Extensive deposits of the ore were mined at Boolcunda in South Australia some years ago. Deposits are being actively worked at the present time at Pernatty, Hawker, and Gordon. The production in 1923 was valued at £1,581. The Pernatty ore is of high grade, and being free from deleterious substances is specially suited for use in making high-grade steel. In Western Australia ores of the metal are found widely scattered, the black oxide being especially plentiful in the Kimberley district. Extensive deposits exist in a locality 18 miles north-west from Peak Hill. In the northern part of the Cue district the deposits cannot at present be profitably worked owing to absence of cheap transport facilities. The export of manganese in 1923 consisted of 22 tons, valued at £200.

8. **Molybdenum.**—Owing to the lack of demand for the mineral there was no production of molybdenite in New South Wales during the year 1921, and only 2 tons, valued at £320, were raised in 1922 in conjunction with mining for bismuth. The production in 1923 amounted to 9 tons, valued at £1,816, obtained from mines at Kingsgate and Dundee in the Glen Innes division. Prospecting was carried on in the Dalmorton and Kempsey divisions. The total production of molybdenite since its discovery is stated at 810 tons, valued at £208,000. In Victoria 2,000 tons of molybdenite ore producing 50 tons of concentrates valued at £6,250, were raised in 1923 at Everton. The production in Queensland for 1923 was 9½ tons, valued at £2,069, raised almost entirely on the Chillagoe field. The Wombah mine near Mount Perry is regarded by geologists as one of the most promising sources of molybdenite in Australia. A small quantity was produced in 1914 from the mines in the Moonta district in South Australia, and the occurrence of the metal is reported from various other localities. At the Yelta mine bunches of the ore are scattered through the copper ore. Molybdenite occurs in small quantities at various localities in Western Australia, the production recorded in 1922 being valued at £500, but none was recorded in 1923. In the Northern Territory, molybdenite is found at Yenberrie, where it is stated that the ore increases in richness as the workings become deeper.

9. **Radium.**—Deposits of radio-active ores occur in lode form in South Australia, and are believed to be richer and more extensive than any others so far located. There is an extensive deposit at Radium Hill, Olary, about 12 miles from Cutana railway siding, and another at Mount Painter in the Northern Flinders Ranges. Ores from both localities have yielded radium. Pure radium bromide was produced at a treatment plant in Sydney, and up to the end of 1914, when operations were suspended, 466 milligrammes were extracted. The Radium and Rare Earths Treatment Co. has been formed to exploit the radio-active ores at Olary, and a syndicate has taken up the workings at Mount Painter.

10. **Tungsten.**—Wolfram and scheelite, the principal ores of tungsten, are both mined to some extent in New South Wales, but the low prices obtainable caused a cessation of mining activity in this direction in the last three years. A large proportion of the total production from tungsten ores is obtained from the wolfram worked at Torrington, but, the production in 1923 amounted to 2 tons only. The deposits at Hillgrove are the principal source of scheelite. In Victoria the production of wolfram was returned in 1920 as 7½ tons, valued at £355, yields being obtained at Mount Murphy and the Tambo River, but there was no subsequent production. In Queensland, tungsten ores are found in several districts, but owing to low prices production in 1923 was suspended. (See also "Bismuth.") A deposit of wolfram was discovered near Yankalilla, in South Australia, as far back as 1893, but the production up to date has been small. It is believed that careful examination will lead to increased production from the deposits at Callawonga Creek. There was no production of tungsten minerals in 1923 in Western Australia. Tungsten ores are commonly met with in the gold reefs, and both wolfram and scheelite have been recorded as occurring in several widely-separated localities. In the Northern Territory wolfram is found at Hatches Creek, Wauchope Creek, Wolfram Creek, Hidden Valley and Yenberrie. Numerous samples of high grade ore have been obtained at the Frew River in Central Australia. The production in 1923 was, however, trifling. Wolfram is mined at various points in Tasmania, the production for 1923 being 97 tons, valued at £6,150, obtained chiefly at the Avoca mines. Scheelite has been discovered on King Island in Bass Strait, but there was no production in 1923.

11. **Other Metals.**—In addition to the metals enumerated above there is a large number of others occurring in greater or less degree, while fresh discoveries are being constantly reported.

§ 10. Coal.

1. **Production in each State.**—A historical account of the discovery of coal in each State will be found in preceding issues of the Year Book. (See No. 3, pp. 515–6.) The quantity and value of the production in each State, and in Australia, during the five years 1919 to 1923, are given in the table hereunder:—

COAL.—PRODUCTION, 1919 TO 1923.

Year.	N.S.W.	(a) Victoria.	Q'land.	S. Aust.	W. Aust.	Tasmania.	Australia.
			QUANTITY.				
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1919 ..	8,631,554	423,945	931,631	..	401,713	66,253	10,455,096
1920 ..	10,715,999	442,241	1,109,913	..	462,021	75,429	12,805,603
1921 ..	10,793,387	514,859	954,763	..	468,817	66,476	12,798,302
1922 ..	10,183,133	559,284	958,519	..	438,443	69,238	12,208,617
1923 ..	10,478,513	476,823	1,060,662	..	420,714	80,718	12,517,430
			VALUE.				
	£	£	£	£	£	£	£
1919 ..	5,422,846	372,075	614,307	..	270,355	47,004	6,726,587
1920 ..	7,723,355	464,739	841,551	..	350,346	64,005	9,443,996
1921 ..	9,078,388	603,323	831,483	..	407,117	63,446	10,983,757
1922 ..	8,507,946	664,251	840,472	..	381,555	61,016	10,455,240
1923 ..	8,607,892	525,270	925,227	..	368,949	70,797	10,498,135

(a) Exclusive of brown coal.

The figures for Victoria quoted above are exclusive of brown coal, the quantity and value of which during the last five years were as follows :—

BROWN COAL.—PRODUCTION, VICTORIA, 1919 TO 1923.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Tons.	£		Tons.	£
1919	111,628	34,542	1922	90,402	31,179
1920	162,682	64,180	1923	116,888	38,019
1921	79,224	31,074			

2. **Distribution and Quantity of Coal in each State.**—(i) *New South Wales.* The collieries in the Northern, Southern, and Western coal-fields are contained in an area of less than 1,000 square miles, and the amount of coal available therein is estimated at 20,000,000,000 tons.

In addition to this quantity of high-grade coal, it is believed that 40,000,000,000 tons of good coal may be won in the remaining 15,000 square miles comprising the Coal Measures area.

Further, the quantity of inferior coal which may be brought to the commercial stage by washing and other means is set down provisionally at 60,000,000,000 tons.

The combined total of these estimates reaches 120,000,000,000 tons, of which the actual reserves of good coal may be stated at 20,000,000,000 tons.

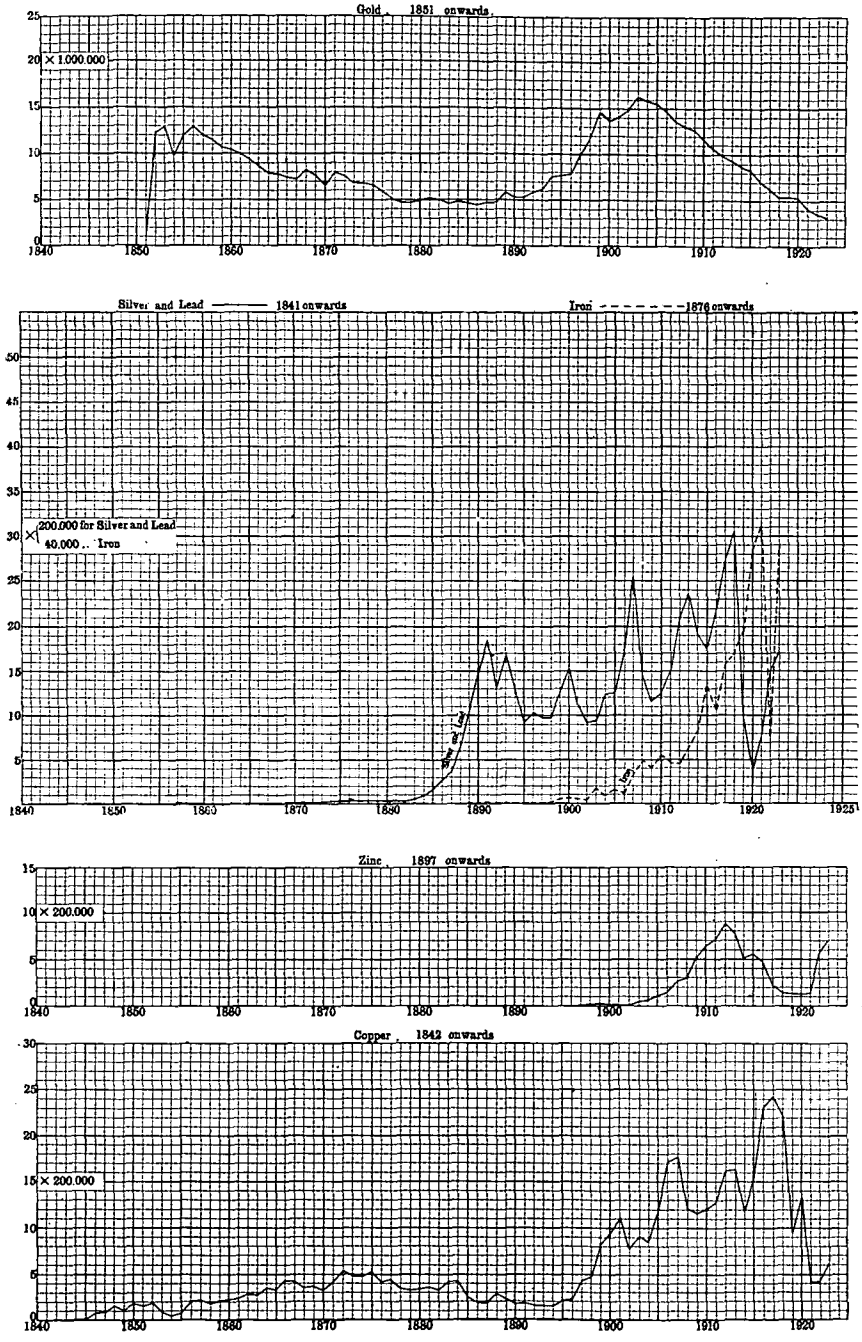
According to Mr. E. F. Pittman, the coal-bearing rocks of New South Wales may be classified as follows :—

COAL-BEARING ROCKS OF NEW SOUTH WALES.

Geological Age.	Maximum Thickness of Coal-bearing Strata.	Locality.	Character of Coal.
	Approx.		
I. Tertiary—Eocene to Pliocene ..	100 ft.	Kiandra, Gulgong, and Chouta Bay	Brown coal or lignite
II. Mesozoic—Triassic or Trias-Jura	2,500 ,,	Clarence and Richmond Rivers	Coal suitable for local use only
III. Palæozoic—Permo-Carboniferous	13,000 ,,	Northern, Southern, and Western Coalfields	Good coal, suitable for gas, household and steaming
IV. Palæozoic—Carboniferous ..	10,000 ,,	Stroud, Bullah Dellah	Very inferior coal, with bands ; of no value

In regard to the Tertiary deposits, it may be noted that no serious attempt has been made to use the coal as fuel in New South Wales. At Kiandra a deposit of lignite was found to possess a maximum thickness of 30 feet, but as a general rule the seams vary from 3 to 4 feet in thickness. The Triassic or Trias-Jura deposits in the Clarence and Richmond districts contain numerous seams, but the coal is largely intersected by bands, while its high percentage of ash renders it unfit for use as fuel for industrial purposes. These beds extend under the great western plains, but the presence of artesian water precludes the possibility of their being worked. The Clarence basin extends into Queensland, and at Ipswich thick and valuable seams of coal are worked. There is also the Coorabin (Riverina) field, an isolated basin with coal from 8 ft. to 36 ft. in thickness over an area of 15 square miles. It is in the Permo-Carboniferous division that the great productive coal seams of the State are found, the area which they cover being estimated at about 16,550 square miles. The deepest part of the basin is somewhere in the vicinity of Sydney, where the "Sydney Harbour Colliery" worked the top seam at a depth of 2,884 feet. It is stated that the coal is specially suitable for coke manufacture. The mine, which is the deepest coal mine in Australia, recommenced operations in September, 1923, after having been idle for nearly nine years. Towards the north, south and west the seams rise towards the surface, and outcrop in the neighbourhood of Newcastle, Bulli and Lithgow. The coal from the various

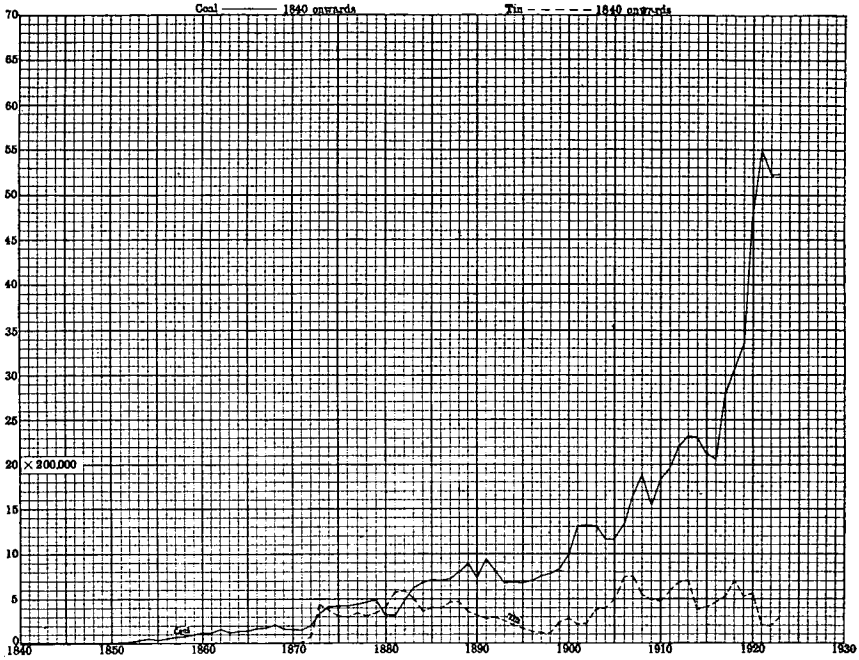
VALUES OF THE PRINCIPAL MINERALS PRODUCED—AUSTRALIA, 1842 TO 1923.

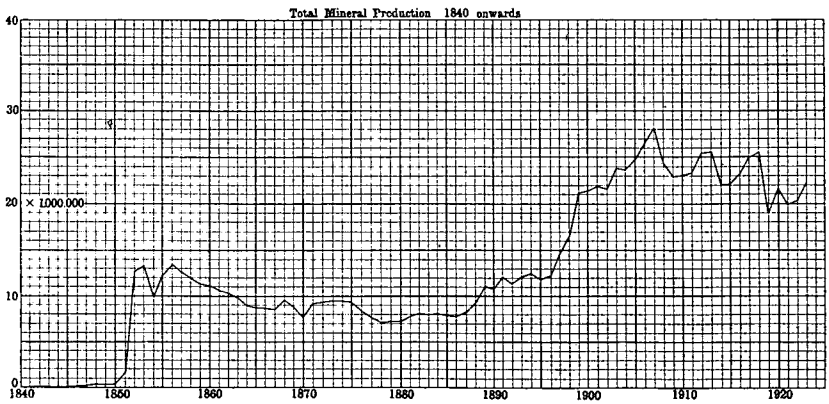


EXPLANATION.—The values shown are those of the total Australian production of certain of the most important minerals in successive years from 1840 to 1923.

The base of each small square represents an interval of one year, and the vertical height represents in the case of gold £1,000,000; in the case of silver and lead, zinc, and copper £200,000; and in the case of iron, £40,000.

VALUES OF PRINCIPAL MINERALS PRODUCED—AUSTRALIA, 1840 TO 1923—*continued.*





EXPLANATION.—The values shown are those of the total Australian production of certain of the most important minerals in successive years from 1840 to 1923.

The base of each small square represents an interval of one year, and the vertical height represents in the case of coal and tin £200,000, and in the case of total mineral production £1,000,000.

districts embraced in this division differs considerably in quality—that from the Newcastle district being especially suitable for gas-making and household purposes, while the product of the Southern (Illawarra) and Western (Lithgow) is an excellent steaming coal. At the present time the Greta coal seams are being extensively worked between West Maitland and Cessnock, and this stretch of country, covering a distance of 15 miles, is now the most important coal-mining district in Australasia. The Permo-Carboniferous measures have in various places been disturbed by intrusions of volcanic rocks, which in some instances have completely cindered the seams in close proximity to the intrusive masses, while in other instances the coal has been turned into a natural coke, portion of which realized good prices as fuel.

The table hereunder gives the yields in each of the three districts during the five years 1919 to 1923 :—

COAL.—PRODUCTION IN DISTRICTS, NEW SOUTH WALES, 1919 TO 1923.

District.	1919.	1920.	1921.	1922.	1923.
	Tons.	Tons.	Tons.	Tons.	Tons.
Northern	5,629,253	7,320,510	7,493,002	7,156,921	6,861,759
Southern	1,826,574	1,902,889	2,062,958	1,878,594	2,170,699
Western	1,175,727	1,492,600	1,237,427	1,147,618	1,446,055
Total	8,631,554	10,715,999	10,793,387	10,183,133	10,478,513

The output in 1921 was the highest yet recorded, the decrease in 1922 being to some extent accounted for by the closing down of the steel works at Newcastle. The decline in production shown by the Northern district in 1923 was brought about mainly by stoppage of work on the Maitland coal-field from April to the beginning of August.

(ii) *Victoria.* (*a*) *Black Coal.* The deposits of black coal in Victoria occur in the Jurassic system, the workable seams, of a thickness ranging from two feet three inches to six feet, being all in the Southern Gippsland district. It is stated that the actual reserves of bituminous coal amount to about 15 million tons, or, including seams 2 feet and over at depths between 4,000 and 6,000 feet to 25 million tons. The tonnages of extractable black coal in the Korumburra, Jumbunna and Outtrim districts are given as 1,305,000 tons, 600,000 tons, and 160,000 tons respectively, while the Wonthaggi area is capable of yielding about 20 million tons.

The output of black coal from the chief Victorian collieries during the last five years was as follows :—

BLACK COAL.—PRODUCTION, VICTORIA, 1919 TO 1923.

Year.	State Coal Mine.	Outtrim Coal Syndicate.	Jumbunna Coal Company.	Coal Creek.	Austral Coal.	Powlett North Woolamai.	Sunbeam Collieries.	Total Production.	Value.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	£
1919 ..	361,871	..	21,716	1,465	11,824	22,335	4,734	423,945	372,075
1920 ..	376,285	..	19,644	753	12,260	23,310	9,989	442,241	464,739
1921 ..	451,255	3,021	13,284	595	10,018	20,255	16,431	514,859	603,323
1922 ..	511,174	1,947	15,423	..	12,570	..	9,770	(*a*)559,284	664,251
1923 ..	418,394	2,562	9,246	..	9,309	..	12,245	(*b*)476,823	523,270

(*a*) Includes also Cardiff Colliery, 3,488 tons; South Gippsland Coal Co., 2,889 tons; Outtrim Extended, 1,813 tons; Gippsland Coal Co., 180 tons; and Strezlecki Co-operative, 30 tons.

(*b*) Includes also Cardiff Colliery, 11,934 tons; Outtrim North, 1,100 tons; Outtrim Extended, 3,936 tons; Dudley Syndicate, 3,998 tons; South Gippsland Co., 4,006 tons; and Mount Pleasant, 93 tons.

(*b*) *Brown Coal.*—(1) *General.* Deposits of brown coal and lignite of immense extent occur in gravels, sands, and clays of the Cainozoic period throughout Gippsland, Mornington Peninsula, Werribee Plains, Gellibrand, and Barwon and Moorabool basins. In the

Latrobe Valley, the beds reach a thickness of over 800 feet. When dried, the material makes good fuel, but owing to its excessive combustibility and friability requires to be consumed in specially constructed grates. Its steaming value is equal to about half that of the Wonthaggi coal. Some large factories already have adopted brown coal for firing boilers, and there is also a fair demand for the product by householders. In 1917 an Advisory Committee appointed to report on the brown coal deposits of Victoria recommended the establishment of an open-cut mine at Morwell in connexion with a comprehensive scheme of electrical power generation and transmission, as well as for the supply of brown coal for other requirements. The recommendations of this Committee were incorporated in the "Electricity Commissioners Act" of 1918. The Commission is actively engaged in the work of opening up the Morwell deposits, and the product will be utilized for the generation of electricity, which will be transferred to Melbourne and to other towns in Victoria within economic distance. The first generator at the Yallourn power station was brought into operation on the 15th June, 1924, and is now assisting in meeting the increasing demands for electric energy in the metropolitan area. A briquetting plant estimated to cost £400,000 has been put in hand, and the manufacture of briquettes on a commercial scale has been undertaken. The capacity of this plant will be about 350 tons per day. A township has been established at Yallourn, with provision for an ultimate population of 3,000. On the 30th June, 1924, there were 2,727 employees engaged on the various works of the Commission as follows:—At Yallourn, 1,686; Transmission Lines, 251; Metropolitan Works, 293; Water Power Investigation, 40; District Undertakings, 106; Brown Coal Mine (old open cut), 351. It is expected that the complete power station and plant will be in operation in 1925. Based on the results from boring, it has been estimated that 10,378 million tons of brown coal are available in the various beds, the bulk of it being in the Morwell and Traralgon areas, which each contain approximately 5,000 million tons. A recent estimate has, however, placed the total supplies at over 20,000 million tons.

The brown coal produced in Victoria is raised chiefly at the State Mine at Morwell, where the output in 1923 amounted to 115,045 tons. During the year 1,009 tons were also raised by the Otway Coal Co., at Bambra, and 834 tons by the Victorian Central Coal and Iron Co. at Lal Lal.

(2) *Production of Briquettes.* The Victorian production of briquettes amounts to about 108,000 tons a year which it is hoped to increase shortly to 300,000 tons, and ultimately to one million. According to the Report of the Geological Survey of the United States the world's production of briquettes in 1923 was 37½ million tons, of which over 23 million tons were produced in Germany.

(iii) *Queensland.* The coal-bearing strata in Queensland are of vast extent and wide distribution, deposits being found in many portions of the Central and Southern Districts, and in a few localities in the Northern and Western Districts. On the south-eastern portion of the seaboard the mineral occurs over a length of 200 miles, whilst inland there is an uninterrupted stretch of coal measures extending over a distance of 600 miles. The geologically surveyed coal areas cover 73,000 square miles, of which 20,000 square miles are made up of recognized coal-fields, the balance consisting of lands known to contain coal but not yet sufficiently examined. Geologically the coal measures belong to the Mesozoic and Palæozoic ages, the systems represented being the upper cretaceous (Desert Sandstone and Rolling Downs); Trias-Jura (Ipswich and Burrum), and Permo-Carboniferous (Tolmies, Clermont, Dawson, and Mackenzie). Most of the coal supplies are obtained from the Trias-Jura measures, the Cretaceous deposits being of minor importance. The inland Permo-Carboniferous areas have not been exploited to any great extent, and their greater development depends on the provision of railway facilities. It is stated that the actual coal reserves in Queensland amount to about 412 million tons, while the probable reserves are set down at over 2,201 millions. Hydrous coals occur at Callide, Hughenden, and Waterpark Creek; gas coals are well represented by the deposits at Walloon, Warwick, Waterpark, and Dalby; the best steam coals are found at Burrum, Ipswich, Styx River, and Clermont. The Ipswich and Burrum coals are well adapted for coke-making, as also are some of the coals from Styx River, Dalby, Warwick, and Clermont.

The distribution of production during the last three years was as follows :—

COAL PRODUCTION.—QUEENSLAND, 1921 TO 1923.

Districts.	1921.	1922.	1923.
	Tons.	Tons.	Tons.
Ipswich	666,236	579,184	607,983
Darling Downs	94,044	93,524	94,760
Wide Bay and Maryborough	69,633	79,305	74,215
Rockhampton (central)	30,719	68,075	108,890
Clermont	75,549	104,141	50,553
Bowen (State Coal Mine)	2,138	11,806	91,643
Mount Mulligan (Chillagoe)	16,444	22,484	32,618
Total	954,763	958,519	1,060,662

The production in 1923 was higher than the average for the preceding ten years, but was a little below that of 1920, the year of maximum output.

Operations were commenced at the State Coal Mine on the Bowen field in March, 1919. The coal is of excellent quality and is well suited for coking. With the completion of the railway to the field, it is anticipated that supplies of coke will be forwarded to the smelters at Chillagoe, Irvinebank, and Cloncurry, the coke for which has hitherto been obtained chiefly from New South Wales. The line was opened for traffic on the 24th August, 1922. Coal of excellent quality is raised from the State Coal Mine at Hartley (Styx River), in the Rockhampton division. This coal has been used with entirely satisfactory results on the ships of the Australian Navy. There are also State Coal Mines at Baralaba, in the Mount Morgan area, and at Mount Mulligan.

(iv) *South Australia.* Thin seams of black coal similar to the Jurassic coal of Victoria have been proved by a bore at Robe, but the depth at which the seams were located, i.e., between 2,830 feet and 3,950 feet, renders exploitation thereof unlikely. The seams of sub-bituminous coal at Kuntha Hill, 110 miles north of Marree, and at Lake Phillipson, are of good quality, but too far away from existing means of transport. At Leigh Creek there is a very large deposit, only partly explored, of sub-bituminous coal, but it is 170 miles distant from the nearest port. The chief hope for its utilization lies in its employment in pulverized form for railway purposes. At Noarlunga, 25 miles by rail from Adelaide, the proved lignite deposits contain 1,438,000 tons. The deposits at Moorlands, 87 miles by rail from the capital, contain an estimated quantity of 8,175,000 tons. At Clinton, 55 miles by sea from Port Adelaide, boring has proved the existence of 32,384,000 tons. Bores at Inkerman, 58 miles by rail from Adelaide, have revealed an estimated deposit of 10,701,000 tons. The mineral has also been located at Hope Valley, 8 miles by road from Adelaide, but no estimate has been made of tonnage. Altogether, the total reserves of lignitic fuel exceed 50 million tons, and further research will undoubtedly considerably increase this figure. South Australian lignite has a high sulphur content, and the effect of this constituent as regards the method of utilizing the deposits will need special investigation.

(v) *Western Australia.* The coal seams in Western Australia belong to the Carboniferous, Mesozoic, and Post-tertiary ages. Most of the coal contains a large proportion of moisture, and belongs partly to the hydrous bituminous and partly to the lignite class. The only coalfield at present worked is at Collie, in the Permo-Carboniferous beds. The area occupied by the coal measures is approximately 50 square miles, and the beds attain a thickness of over 2,000 feet, the coal seams totalling 137 feet. Two distinct types of coal, designated respectively the Proprietary and Collie Burn, have been recognized. The former is dull and porous, with a thinly-banded structure and much " mother of coal," and is characterized by a tendency to crumble on exposure, by its free burning, and lack of smoke. The Collie-Burn type is bright and compact, less laminated, almost free from mother of coal, clear and firm, and, while burning less freely, gives off an appreciable amount of smoke.

Estimates place the amount of available coal on the field to a depth not exceeding 2,000 feet at 3,500 million tons. About 5½ miles north-east of Wilga, on the Donnybrook-Preston Valley Railway, a deposit of coal occurs which appears to be an extension of the Collie fields. Its area, however, has not yet been determined, but boring is in progress and good seams have been located.

Beds of Permo-Carboniferous coal are found in the Irwin River area, and a seam believed to be a northern prolongation of the Irwin River measures has been located in the valley of the Greenough River. Coal has also been found at Fly Brook, one of the branches of the Donnelly River, on the South Coast, and in the neighbourhood of the Vasse River, which flows into Geographe Bay.

Other discoveries have been made at Millbrook on the Blackwood River, and in the valley of the Fitzroy River in the Kimberley area.

The production from the five collieries situated at Collie amounted in 1923 to 420,714 tons, as compared with 438,443 tons in 1922. If the demand for coal warranted it, the output from any of the collieries could be considerably increased.

(vi) *Tasmania.* The commercial value of the Tasmanian coals varies according to their age, the oldest, i.e., the Permo-Carboniferous, being of much greater value than the youngest, i.e., the Tertiary. At present there are not sufficient data available regarding the extent and distribution of the Tertiary deposits, although it is known that they occur in all quarters of the island, and that some of them contain workable seams. Both the Trias-Jura and Permo-Carboniferous coals are valuable for domestic purposes, but the Trias-Jura seams are thicker and more extensive, and hence more largely worked. Permo-Carboniferous coals have been mined for many years for domestic purposes at Mersey, and the Preolenna and Barn Bluff fields contain coals of high potential value. The total quantity of coal available for payable extraction has been estimated at approximately 135 million tons, or on the basis laid down by the International Geological Congress, 125 million tons actual reserve, and 123 millions probable reserve.

Of the total output in 1923, amounting to 80,718 tons, the Cornwall and Mt. Nicholas Collieries in the North-eastern Division raised 43,068 and 32,457 tons respectively. About 1,800 tons were produced from the Catamaran Colliery; 1,200 tons from the Cardiff-Jubilee Colliery, and smaller quantities from Spreyton, York Plains, Illamatha, Preolenna and Allison.

3. Production in Various Countries.—The total known coal production of the world in 1923 amounted to about 1,197 million tons, towards which Australia contributed over 12½ million tons, or about 1 per cent. The following table shows the production of the British Empire and the chief foreign countries in units of 1,000 tons during each of the five years from 1919 to 1923 where the returns are available. The figures for the British Empire and the United States have been extracted chiefly from the official publications of the various countries, while those for other countries are taken from the Official Monthly Bulletin of Statistics, published by the League of Nations. The production of lignite is included in those countries in which it is raised :—

COAL PRODUCTION.—BRITISH EMPIRE, 1919 TO 1923.

Year.	United Kingdom.	British India.	Canada.	Australia.	New Zealand.	Union of S. Africa.
	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.
1919	229,800	22,600	12,200	10,500	1,848	9,200
1920	229,500	17,100	14,400	12,800	1,844	10,200
1921	163,200	18,400	10,500	12,800	1,809	10,200
1922	249,600	18,200	10,000	12,200	1,858	8,700
1923	276,900	18,800	16,984	12,600	1,970	10,700

COAL PRODUCTION.—FOREIGN COUNTRIES, 1919 TO 1923.

Year.	Germany.	Belgium.	France.	Czecho-Slovakia.	Poland.	Netherlands.	Japan.	United States.
	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.
1919 ..	207,100	18,200	21,500	27,000	..	3,400	30,800	494,600
1920 ..	215,900	22,000	34,100	30,300	30,547	3,900	28,800	587,700
1921 ..	235,100	21,400	37,900	32,600	29,343	3,900	25,800	452,100
1922 ..	252,100	20,900	42,500	28,400	34,267	4,500	27,200	425,800
1923 ..	177,600	22,600	47,000	27,400	35,518	5,200	26,000	572,100

More than half the production in Germany and Czecho-Slovakia was represented by lignite. As a result of the conditions of the Versailles Treaty, Germany has been transformed temporarily from a bituminous coal producing country into one mainly turning out lignite. So far as Central Germany is concerned, the production of lignite increased from 35 million tons in 1913–14 to about 60 millions in 1922–23, more than half the output being converted into briquettes.

4. **Exports.**—The exports of coal from Australia are chiefly confined to New South Wales.

The total quantity of coal of Australian production (exclusive of bunker coal) exported to other countries in 1923-4 was 1,336,489 tons, valued at £1,460,168, all of which, with the exception of 6 tons, was exported from New South Wales.

In the following table will be found the quantity and value of the exports from New South Wales, during the last five years. The figures are given on the authority of the Mines Department of that State, and include both bunker coal and coal exported from New South Wales to other States.

COAL.—EXPORTS, NEW SOUTH WALES, 1919 TO 1923.

Year	1919.	1920.	1921.	1922.	1923.
Quantity, 1,000 tons	3,504	4,987	5,525	5,239	4,900
Value, £1,000	2,919	4,591	5,794	5,929	5,481

Arranged in order of importance the principal oversea countries to which coal was exported from New South Wales during the year 1923–24 are as shown hereunder. The quantity and value refer strictly to exports, and exclude bunker coal :—

COAL.—DESTINATION OF OVERSEA EXPORTS, NEW SOUTH WALES, 1923-24.

Country.	Quantity.	Value.	Country.	Quantity.	Value.
	Tons.	£		Tons.	£
New Zealand ..	731,393	803,152	Fiji	20,528	21,207
Philippine Islands	143,199	160,088	India	10,558	10.985
Chile	117,147	124,225	Society Islands ..	7,771	8,185
Netherlands East Indies ..	93,500	101,369	Ceylon ..	7,000	7,875
Malaya (British) ..	71,976	76,913	Gilbert and Ellice Islands ..	7,657	7,543
Peru	36,120	40,106	New Guinea ..	5,932	7,351
United States ..	34,091	37,627	Nauru ..	3,754	3,468
New Caledonia ..	21,811	23,625	Egypt	1,133	1,133
Hawaiian Islands	21,681	23,332			

The quantity of bunker coal taken from Australia by oversea vessels in 1923–24 was about 1,276,000 tons, of which 1,148,000 tons were supplied by New South Wales.

The distribution of the total output from New South Wales collieries during the last five years was as follows, the particulars given of quantity exported including coal shipped as bunker coal :—

COAL.—DISTRIBUTION OF OUTPUT, NEW SOUTH WALES, 1919 TO 1923.

Year.	Exports to Australian Ports.	Exports to Foreign Ports.	Local Consumption.	Total.
	Tons.	Tons.	Tons.	Tons.
1919	1,891,317	1,611,701	5,128,536	8,631,554
1920	2,270,556	2,716,235	5,729,208	10,715,999
1921	2,752,810	2,771,949	5,268,628	10,793,387
1922	2,841,253	2,398,144	4,943,736	10.183,133
1923	2,518,579	2,381,549	5,578,385	10,478,513

Of the total coal exports from New South Wales, amounting in 1923 to 5,578,000 tons, about 4,042,000 tons were shipped from the port of Newcastle.

The figures quoted above are given on the authority of the New South Wales Mines Department.

5. Consumption in Australia.—An estimate of the consumption of coal in Australia may be arrived at by adding the imports to the home production, and deducting the exports (including bunker coal taken by oversea vessels). The following table shows the consumption computed in the manner specified, for the last five years:—

COAL.—CONSUMPTION, AUSTRALIA, 1919 TO 1923.

Year.	Quantity of Coal Consumed.		
	Home Produce.	Produce of Other Countries.	Total.
	Tons.	Tons.	Tons.
1919	9,036,623	64,673	9,101,296
1920	10,132,442	26,828	10,159,270
1921	9,776,978	9,457	9,786,435
1922	9,531,274	46,620	9,577,894
1923	10,022,228	62,660	10,084,888

The bunker coal taken away in 1923 was estimated at 1,276,000 tons.

6. Prices.—(i) *New South Wales.* The price of New South Wales coal depends on the district from which it is obtained, the northern (Newcastle) coal always realizing a much higher rate than the southern or western product. The average rate in each district during the last five years was as follows:—

COAL.—PRICES, NEW SOUTH WALES, 1919 TO 1923.

Year.	Northern District.		Southern District.		Western District.	
	Per ton.		Per ton.		Per ton.	
	s.	d.	s.	d.	s.	d.
1919	13	6	11	10	9	4
1920	15	3	13	4	11	8
1921	17	7	16	6	12	10
1922	17	6	16	3	12	8
1923	17	7	16	1	11	5

(ii) *Victoria.* In Victoria the average price of coal in 1918 was 15s. 11d.; in 1919, 17s. 7d., in 1920, 21s.; in 1921, 23s. 5d.; in 1922, 23s. 9d.; and in 1923, 22s. per ton. These averages are exclusive of brown coal, the production of which in 1923 was valued at 6s. 6d. per ton.

(iii) *Queensland.* Prices in the principal coal-producing districts during the last five years were as follows:—

COAL.—PRICES, QUEENSLAND, 1919 TO 1923.

District.	Value at Pit's Mouth.									
	1919.		1920.		1921.		1922.		1923.	
	Per ton.		Per ton.		Per ton.		Per ton.		Per ton.	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Ipswich	12	7	14	7	16	6	16	8	16	11
Darling Downs	14	10	16	7	18	10	18	11	19	1
Wide Bay and Maryborough	19	2	23	3	27	3	27	2	25	0
Rockhampton	13	4	16	1	15	6	16	5	15	5
Clermont	11	2	13	0	14	4	13	10	12	10
Bowen (State Coal Mine) ..	15	0	15	10	16	3	16	1	16	0
Mount Mulligan (Chillagoe)	17	8	19	0	19	10	20	0	22	6
Average for State ..	13	2	15	2	17	5	17	6	17	5

The readjustment of prices and wages in the industry was responsible for the increases in the averages during the last four years.

(iv) *Western Australia.* The average price of the Collie (Western Australia) coal during the last five years was as follows:—In 1919, 13s. 5d; in 1920, 15s. 2d.; in 1921, 17s. 4d.; in 1922, 17s. 5d.; and in 1923, 17s. 6d. per ton.

(v) *Tasmania.* The average price per ton of coal at the pit's mouth in Tasmania for the five years 1918 to 1922 was:—In 1918, 12s. 6d.; in 1919, 14s. 2d.; in 1920, 16s. 11½d.; in 1921, 19s. 1d.; in 1922, 17s. 7d.; and in 1923, 17s. 6d. per ton.

7. **Prices in the United Kingdom.**—During the five years 1918 to 1922 the average value of coal at the pit's mouth in the United Kingdom was:—In 1918, 20s. 11d.; in 1919, 27s. 4d.; in 1920, 34s. 7d.; in 1921, 26s. 2d.; and in 1922, 17s. 7d. per ton.

8. **Employment and Accidents in Coal Mining.**—The number of persons employed in coal mining in each of the States during the year 1923 is shown below. The table also gives the number of persons killed and injured, with the proportion per 1,000 employed, while further columns are added showing the quantity of coal raised for each person killed and injured, this being a factor which must be reckoned with in any consideration of the degree of risk attending mining operations. A further table gives the rate of fatalities during the last five years.

According to the report of the Chief Inspector of Mines for Great Britain, the average death-rate per 1,000 miners from accidents in coal mines during the quinquennium 1915–19 was 1.27, while, as shown in the table following, the rate for Australia for the quinquennium 1918–1922, was 1.57. In the United States the fatality rate per 1,000 employees, as stated in "The Mineral Industry," was 3.94 in 1918, 4.39 in 1919, and 3.63 in 1920.

COAL MINING.—EMPLOYMENT AND ACCIDENTS, 1923.

State.	Persons Employed in Coal Mining.	No. of Persons.		Proportion per 1,000 Employed.		Tons of Coal Raised for each Person.	
		Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
New South Wales ..	22,989	31	101	1.35	4.39	338,000	103,700
Victoria	2,131	1	11	0.47	5.16	594,000	54,000
Queensland ..	2,662	2	11	0.75	4.13	530,000	96,400
Western Australia ..	713	..	62	0.00	86.96	..	6,800
Tasmania	318	1	3	3.14	9.43	81,000	26,900
Total ..	28,813	35	188	1.21	6.52	361,000	67,200

The figures for New South Wales include 20 shale miners, of whom one was injured. In 1922 the deaths from accidents in coal mines in this State numbered 12, the increase in 1923 being due to the disaster at the Bellbird colliery which caused the death of 21 persons. Owing to lack of uniformity in the definition of "injury," the figures relating to persons injured possess little value.

The next table shows the average number of miners employed, the number of fatalities, and the rate per 1,000 during the quinquennium 1919–23:—

COAL MINING.—FATALITIES, 1919 TO 1923.

State.	Average No. of Coal Miners.	Average No. of Fatal Accidents.	Rate per 1,000 Employed.
New South Wales	20,806	19.8	0.95
Victoria	2,058	2.4	1.17
Queensland	2,476	19.0	7.67
South Australia	4	..	..
Western Australia	777	0.6	0.77
Tasmania	241	0.2	0.83
Total	26,362	42.0	1.59

Figures for coal miners in South Australia appear for the first time in 1922, the miners being engaged chiefly on work in connexion with the brown coal deposits.

The abnormally heavy rate in Queensland is due to the inclusion of the 75 deaths in 1921 caused by the disastrous explosion of coal-dust at Mount Mulligan. For the quinquennium 1916–20 the Queensland rate was 1.79, and for the whole of Australia 1.14.

§ 11. Coke.

1. **Production.**—Notwithstanding the large deposits of excellent coal in Australia there was, prior to the war, a fairly considerable amount of coke imported from abroad. During recent years, however, a high standard of excellence has been attained in the local product, and the necessity for import has therefore disappeared. The table hereunder gives the production in New South Wales during the last five years:—

COKE.—PRODUCTION, NEW SOUTH WALES, 1919 TO 1923.

Year		1919.	1920.	1921.	1922.	1923.
Quantity ..	tons	424,773	567,569	592,097	240,229	580,374
Value, total ..	£	550,127	844,191	1,029,694	382,926	941,323
Value, per ton ..	..	25s. 11d.	29s. 9d.	34s. 9d.	31s. 10d.	32s. 5d.

During recent years the industry has made considerable progress, and with the development of local iron and steel works, as well as metal refineries and smelting establishments, its future prospects ought to be assured. The heavy decline in quantity and value of coke made in 1922 was due to the lessened demand consequent on the closing down of the steel works at Newcastle, while the improvement manifested in 1923 was resultant on the recommencement of operations.

A small quantity of coke is made in Queensland, the quantity returned in 1923 being 5,244 tons, but the bulk of that used in ore reduction is imported, mainly from New South Wales. The following table shows the amount manufactured locally during the last five years:—

COKE.—PRODUCTION, QUEENSLAND, 1919 TO 1923.

Year		1919.	1920.	1921.	1922.	1923.
Quantity ..	tons	4,562	19,653	7,557	6,748	5,244

Information regarding the exact quantity of coke imported from New South Wales and elsewhere is not available.

In order to avoid duplication with coal values the returns for coke have not been included in the general tables of mineral production in the early part of this chapter.

§ 12. Oil Shale and Mineral Oil.

1. **Production.**—(i) *New South Wales.* The production of kerosene shale amounted during 1923 to 1,207 tons, valued at £2,831, as compared with 23,467 tons valued at £60,641 in 1922, the reduction being due to the closing down of the shale mines at Newnes. Up to date there has been no production of petroleum in the State, but boring operations were continued in the Tamworth division, and several areas have been taken up for the purpose of boring in the Picton division. It is estimated that the total quantity of shale in the State amounts to 40 million tons, but its profitable exploitation depends on economic methods of distillation and transportation.

(ii) *Victoria.* Up to the present no extensive deposit of oil shale has been located in Victoria. Bores in search of oil have been put down from time to time, but so far without result, and the State geological authorities take an unfavourable view of the prospects of obtaining it.

(iii) *Queensland.* The discovery of natural gas and traces of oil in a deep bore at Roma fostered the hope that energetic development would lead to the discovery of mineral oil in quantity in this locality. During 1919 the bore reached a depth of 3,705 feet, but further drilling operations were suspended owing to the tools getting fast in the bore early in the year. In February, 1920, a start was made with the work of attempting to recover the tools, but after using various devices without success the task was abandoned. Later, the bore was diverted, and in 1922 this work was continued to a depth of 2,800 feet. Strong evidences of oil were noticed on the water flowing from the bore, but attempts to shut off this water proved unsuccessful, and operations were terminated. Attempts made at the recovery of the petroliferous gas were also unsuccessful. Early in 1924 it was announced that oil-bearing sands has been penetrated between 2117 ft. and 2233 ft. by a bore put down on the Lander Oil Co.'s area at Orallo, near Roma. It is believed that the main body of the oil sands will be located at approximately 4000 ft. Oil-bearing shales are common in many parts of the State, but their extent and nature have not yet been accurately determined. Prospecting for petroleum is still being vigorously conducted at Orallo, and at Tewantin and Beaudesert. A well-known geologist states that one of the causes of the delay in the discovery of petroleum is the absence of signs which would strike the eye of the bushworker. In Queensland, the difficulties in the way of oil prospecting were the soil mantle, and the underlying cretaceo-tertiary which obscured the earth structure in the underlying beds. Bores in the vicinity of Longreach have yielded petroliferous gas and wax, and there seems to be evidence that the Mesozoic strata are oil-bearing.

(iv) *South Australia.* Bitumen is occasionally washed up on the southern coasts of the continent from Port Davey in Tasmania to Cape Leeuwin in Western Australia. Specimens found on Kangaroo Island at one time led to the belief that they were the product of a terrestrial petroliferous area. Similar occurrences of this mineral have been reported from the coasts of California, South Africa, and New Zealand. In 1920 the finding of accumulations of oily matter on the shores at Encounter Bay and Kangaroo Island was reported, but investigations by the Mines Department into the geological conditions of the surrounding country do not encourage the hope that the matter is of local origin. It is stated, however, that the prospects appear favourable over an area in the desert region near Lake Eyre, and in the Coorong district.

(v) *Western Australia.* In this State the chief interest in the search for oil centres in the Kimberley division. At Mount Wynne, in West Kimberley, the gas which bubbles freely in a hot spring has been found to contain hydrocarbons. Indications of free petroleum have been obtained in bores on Price's Creek, about 100 miles south-east of Mount Wynne, and traces of mineral oil have been detected in a seepage. In East Kimberley a black bitumen, residual from an asphaltic oil, has been found in weathered basalt in two localities five miles apart, thus indicating the former circulation of petroleum in the area. Boring operations were in progress during 1923 in the Kimberley area, and several other areas are being geologically examined to determine whether boring is justified.

(vi) *Tasmania.* Oil shale has been discovered in the basins of the Mersey, Don, and Minnow Rivers, and elsewhere, and the Government Geologist estimates the probable capacity of the beds at 12,000,000 tons. Production during the last ten years has, however, been small, the largest yield being in 1916, when 1,286 tons were raised. For 1923 the output was 1,101 tons, valued at £1,094. During the year 1920 an investigation was made of the oil-shale deposits in the North-Western Division. Previously the known occurrences were restricted to small areas near Latrobe, Railton, Nook and Beulah, but it has been proved that the deposits extend over a much larger area in that district, and another field has been discovered near Henrietta. A new method of extracting oil from shale has been successfully tried, and a company has been formed to exploit the process.

(vii) *Northern Territory.* Considerable activity has recently been displayed by speculators in acquiring areas under coal and oil prospecting licences along the north-western boundary of the Territory, and northerly along the western coast to the Daly River, but so far no developments have been recorded, although what are regarded locally as good indications of oil have been discovered.

(viii) *Papua.* In 1911 indications of petroleum were reported near the Vailala River, and, acting on the reports of geologists, an oil-expert was despatched by the Commonwealth Government to sink trial bores on the site. Early in 1913 a small quantity of oil was obtained from a shallow bore. Later on, extensive geological surveys were made of the country between Yule Island and the Purari Delta, and oil was encountered in several trial bores. In 1919 the Anglo-Persian Oil Co., under agreement with the British and Commonwealth Governments, and latterly with the Commonwealth Government only, has been engaged in work on the field. A geological survey and examination has been made of the Papuan Gulf Coast north-west from Yule Island to the Kapuri River district, and a re-examination of areas in the Vailala River area.

(ix) *New Guinea.* At Matapau, about 54 miles from Aitape on the north coast of what was formerly German New Guinea, oil has been struck in a shallow bore, and hopes are entertained that the product will be encountered in large volume at a greater depth.

2. **Expert's Report.**—A report by Dr. Wade presented to the Senate in October, 1924, by the Minister for Home and Territories was generally unfavourable to the prospects of finding commercial supplies of petroleum in the northern portions of Western Australia and the Northern Territory. The report points out that the marginal areas on the Fitzroy apparently offered the best possibilities, and special mention was made of the Price's Creek region, although the structure there was not satisfactory in regard to present geological knowledge. It was recommended that the district should be tested with boring plant capable of penetrating to a depth of between 3,000 and 4,000 feet.

3. **Exports.**—In 1916–17 New South Wales exported a small quantity of shale. There was no export in the succeeding year. In 1919, 5 tons, valued at £21, were exported, in 1920, Victoria was credited with an export of 4 tons, and in 1921, New South Wales exported 103 tons, valued at £440. There was no record of export in 1922, and 11 tons only were exported from New South Wales in 1923.

4. ***Mineral Oil Bounties.***—A statement regarding the bounties payable in respect to the discovery of oil was given in Official Year Book 17, p. 805. The offer by the Commonwealth Government of a reward up to £50,000 for the discovery of oil in Australia was withdrawn in 1925, and it is now proposed to subsidize boring on a £ for £ basis in localities where geological evidence offers reasonable prospects for the discovery of oil. Separate arrangements have been made in regard to the mandated territories.

§ 13. Other Non-metallic Minerals.

1. **Alunite.**—The production of this mineral in New South Wales amounted during 1923 to 998 tons, valued at £3,992, raised in the Bullahdelah division. The mineral is sent to England for treatment, and, to the end of 1923, the exports were 56,000 tons, valued at £200,000.

In South Australia an extensive deposit of the mineral was located in 1913 at Carrickalinga Head, on the coast north of Normanville, and within a short distance of Adelaide. Fresh discoveries were later reported on the western shores of St. Vincent's Gulf. The mineral returns show a production of 95 tons in 1922, but none was recorded in 1923.

The exploitation of the alunite deposits in the North-East Coolgardie field in Western Australia has been retarded pending the result of field experiments to determine the suitability or otherwise of the product as a fertilizer in its unroasted state. Deposits of the mineral are also found in the Kalgoorlie area.

2. **Asbestos.**—This substance has been found in various parts of Australia, but up to the present has not been produced in any considerable quantity. In New South Wales 204 tons of fibre, valued at £4,267, were raised during 1923 from deposits in the Barraba division. In Queensland seams of asbestos have been found over a belt of country extending from Cawarral to Canoona, as well as in other districts. Samples of the fibre proved suitable for the manufacture of fibro-cement sheeting and tiles, but so far the deposits have not been commercially exploited. Deposits of asbestos have been located at various places in South Australia. Production in 1923 amounted to

147 cwt., valued at £161. Chrysotile asbestos of high grade is found in various localities in Western Australia, particularly in the Serpentine rocks between Nullagine and Roeburne, over a distance of 200 miles. The production in 1923 amounted to 115 tons valued at £4,032, obtained in the Nullagine and Marble Bar districts of the Pilbara Goldfield. In 1899 Tasmania raised 200 tons, valued at £363, but there was no further production until 1916, when a small quantity was raised at Anderson's Creek, near Beaconsfield. In 1917, 271 tons, valued at £271; in 1918, 2,854 tons, valued at £5,008, and in 1919, 51 tons, valued at £1,275, were produced, but there was no subsequent record of production.

3. **Barytes.**—In New South Wales during 1921 about 200 tons of barytes, valued at £600, were obtained at Mandurama in the Cowra division. A promising deposit of remarkable purity was further developed during the year at Cavan in the Yass division, and a large deposit was opened up at Kempfield in the Trunkey division. No production was, however, reported for 1922, and 100 tons only, valued at £200, were raised in 1923. The production in South Australia during 1923 was given as 1,761 tons, valued at £5,265. In this State there are extensive deposits of the mineral at Noarlunga and Pernatty Lagoon. First class ore is found near Truro in the hundred of Dutton, and the mineral is also worked near Williamstown. High grade natural white barytes is obtained from some of the workings, but a large amount of lower grade ore is discarded or wasted owing to lack of facilities for cleaning and bleaching. Barytes in fair-sized veins occurs at many places in Western Australia, especially at Cranbrook in the south-west division. The export in 1921 was, however, small, being valued at under £20 and none was recorded in 1923. About 1,000 tons of barytes, valued at £4,000, were produced in Tasmania in 1920, the greater portion being won from deposits near Queenstown and Mt. Jukes, and the balance from Beulah and elsewhere, but there was no production recorded in the last three years.

4. **Clays and Pigments.**—Valuable deposits of clays and pigments of various sorts are found throughout Australia. There is a considerable local production of earthenware, bricks, and tiles, but the finer clays have not as yet been extensively used. In New South Wales the production of pigments amounted in 1923 to 190 tons, valued at £351. About 100 tons of yellow ochre were raised at Eumungerie in the Dubbo division, and small quantities of red ochre and umber were raised in the Gulgong division. About 3,600 tons of white clay were raised from various areas during the year, the deposits at Lidsdale in the Lithgow division being found very suitable for the making of high grade porcelain ware. The output of silica was approximately 19,000 tons, raised chiefly at Lithgow, Ulladulla, and Milton. In Victoria 2,307 tons of kaolin, valued at £2,384, were produced in 1923 from deposits at Stawell, Mt. Egerton, Bendigo, and Pyalong, and 123 tons of pigment clays, valued at £635, were raised from leases at Ballarat and Warragul. In Queensland, 7,399 tons of fireclay, valued at £1,942, were mined during 1923 in the Mount Morgan district. Deposits of fine white clay have been located near Wondai and Kingaroy. On Kangaroo Island, South Australia, where, it is stated, the first pottery mill in Australia was erected, there are vast deposits of felspar, china stone, silica, and firebrick clay. There are also very extensive deposits of fireclay near Ardrossan on the Yorke Peninsula. Ochre deposits of fine quality are found in the Noarlunga area, and a company in this area is producting kaolin, firebricks, and kalsomines. Production of ochre in 1923 amounted to 52 tons, valued at £155. Red oxide of suitable quality as well as ochres of various hues have been found in different and widely-separated localities in Western Australia. A paint and distemper factory has been established in Perth, and this, coupled with the demand from the Eastern States, will further stimulate the search for the necessary materials. Investigation has proved the existence of a deposit of a fine white-ware clay about 4 miles from the railway at Wagin. Porcelain and other clays of good quality have been found in Tasmania at Beaconsfield, Sorell, Hagley, etc. Oil and water paints have been made from coloured ochres from Sorell, and deposits of ochre have been located near Mowbray and Beaconsfield. The production of ochre in 1921 was returned at 15 tons, valued at £56, but none was recorded in 1922 and 1923.

5. **Felspar.**—During 1923, the production of this mineral in New South Wales was 13 tons, valued at £27, raised in the Bathurst division. About 60 tons of felspar, valued at £485, were exported during 1922 from Western Australia, but none was recorded in

1923. A large deposit of the mineral has been located near Jacob's Siding, and it also occurs in the Coolgardie area.

6. **Fluorspar.**—At Carboona in the Tumbarumba division in New South Wales this mineral is mined with silver and lead, but no production was recorded therefrom in 1923. In Victoria 196 tons, valued at £625, were raised in 1921 by a company operating at Walwa, but none was recorded in 1923. A company operating in 1921 at a mine near Emuford in the Herberton district in Queensland produced 536 tons, valued at £1,609, but no production was returned for 1922 or 1923. A high grade fluorspar occurs at the Perseverance mine on the Chillagoe railway, and large quantities can be cheaply mined at shallow depths.

7. **Fuller's Earth.**—About 50 tons of this material, valued at £90, were produced in 1923 from deposits in the Boggabri area of the Narrabri division, New South Wales. A large deposit of excellent quality has been located near Jennacubbine in Western Australia.

8. **Graphite.**—Graphite is found in New South Wales near Undercliff Station, in the county of Buller, and 50 tons were raised during 1922. The product was used in the manufacture of paints, boiler compound, and foundry plumbago, but none was raised in 1923. In Victoria the mineral occurs in Ordovician slates in several of the gold-fields, but is not worked. In Queensland graphite was raised some years ago by the Graphite Plumbago Company at Mt. Bopple, near Netherby, on the Maryborough-Gympie line. There has been no production in recent years, and it is stated that the prospects are not promising for flake graphite, although encouraging for the amorphous variety. In South Australia deposits are found at various places in Eyre's Peninsula. While a large proportion of the product is not suitable for commercial use, the work so far done shows that flake graphite containing as high as 80 per cent. carbon can be obtained. The Government is offering a bonus of £1 per ton for the production of graphite containing not less than 80 per cent. carbon, and on graphite with a smaller percentage, a bonus proportionate to the carbon content. In Western Australia deposits occur at Munglinup Creek, near the Oldfield River, on the Pallinup River in the Kent District, at Northampton, in the Murchison division, and on the Donnelly River at Kendenup, about 40 miles from Albany. Production in 1920 was small, amounting to 13 tons, valued at £130, and practically none was recorded during the last three years.

9. **Gypsum.**—The output of gypsum in New South Wales during 1923 was 2,070 tons, valued at £360, and was obtained in the Hillston division. In Victoria during 1923 there was a production of 12,761 tons, valued at £10,176, of which 969 tons were raised from leases at Boort, Lascelles, and Chillingollah; 1,232 tons at Cowangie; 5,069 tons at Waitchie; 2,568 tons at Bolton; and 2,923 tons at Lake Boga. Numerous deposits of gypsum are found in Southern Yorke's Peninsula, and on the coast near Fowler's Bay, in South Australia, the quantity available being large and of high quality. The production in 1923 amounted to 53,405 tons, valued at £46,729, the largest yet recorded. Considerable impetus will be given to the industry with the completion of railway communication between the deposits at Lake Macdonnell and the works at Cape Thevenard. Gypsum is widely distributed in Western Australia in tertiary and late tertiary deposits associated chiefly with the salt lakes of the arid regions of the interior south of the tropics. Many of these lacustrine deposits are capable of yielding large tonnages. The production in 1921 amounted to 664 tons, obtained at Koorda. In 1922 only 63 tons were recorded, and none was raised in 1923.

10. **Magnesite.**—Deposits of this mineral have been discovered at several localities in New South Wales. During 1923 the output was 6,130 tons, valued at £5,699, of which about 4,620 tons were raised at Attunga in the Tamworth division, and 1,190 tons in the Fifield division. In addition, 360 tons were raised in the Cobar division, but there was no production from the deposits in the Bingara and Braidwood areas. The mineral is found at Heathcote in Victoria, where 75 tons, valued at £225, were produced in 1923. There are deposits in the neighbourhood of Rockhampton and Bowen in Queensland, and a deposit of exceptional purity has been located in the vicinity of Tumby Bay in South Australia, about five miles

from the township of Tumby. The cost of transport is a drawback to the production from the Copley (Leigh Creek) district. The Broken Hill Co. is working a small deposit near the Beetaloo Waterworks. Production in 1923 amounted to 165 tons, valued at £323. A large area of magnesite-bearing country has been located in Western Australia at Bulong, about 20 miles east of Kalgoorlie, and deposits have also been found at Coolgardie and other places. The mineral is of a high degree of purity, but there has been no production of importance since 1915, and 2 tons only were recorded in 1923.

11. **Phosphate Rock.**—During 1923, 34 tons of phosphate, valued at £112, were obtained in New South Wales at Ashford, and about 40 tons were won in the Molong division. In Victoria 480 tons, valued at £713, were raised at Mansfield. The production in Queensland amounted in 1922 to 65 tons valued at £279, raised by the Holbourne Island Phosphate Company in the Bowen district. Difficulty in finding a market for the product was responsible for the small output, and none was raised in 1923. South Australia possesses deposits scattered over a belt of country 200 miles in length, from Myponga in the south to the district round Carrieton, in the north. Production in 1921 amounted to 5,079 tons, valued at £6,203, in 1922 to 2,715 tons, valued at £3,678, but in 1923 there was a decline to 446 tons, valued at £592. It is stated that the industry is meeting with severe competition in the high grade phosphate imported from Nauru. Deposits of guano and phosphate have been found in caves between 27 and 40 miles to the north-east of Carrieton, but they are not of sufficient value to warrant exploitation. In Western Australia the known phosphate deposits occur principally on the coastal islands, and in portion of the coastal plain between Dongarra and Perth. Some years ago guano digging on the islands was a large and profitable industry.

12. **Salt.**—Salt is obtained from salt lakes in the Western and North-western districts of Victoria, and from salterns in the neighbourhood of Geelong. Figures regarding production are, however, not available for publication. Large quantities are obtained from the shallow salt lakes of South Australia, chiefly on Yorke Peninsula. Lake Hart, about 60 square miles in area, situated about 120 miles N.W. from Port Augusta, contains immense supplies of salt of good quality, which at present, however, owing to distance from market, possess no economic value. The salt is simply scraped from the beds of the lakes in summer time and carted to the refinery. It is stated that care must be taken not to leave too thin a crust of salt over the underlying mud, as the resultant "crop" after the winter rains will in that case be smaller than usual. During recent years a fair amount has been produced by evaporation of sea water at the heads of Spencer's and St. Vincent's Gulfs. About 50,000 tons of crude salt, valued at £113,000, were produced during 1923. In Western Australia salt is obtained from depressions in the calcareous sandstones of the coast, which are filled to a shallow depth in winter with salt water. In summer the depressions dry up, leaving a layer of salt two or three inches thick, which is collected and refined. Up to the present, the four chief localities producing salt were Rottnest Island, off Fremantle; Middle Island, near Esperance; Yarra Yarra Lakes, near Three Springs; and Lynton, near Port Gregory. There is a very large number of salt and brine lakes which may ultimately be used as sources of salt.

Attention has recently been devoted to the occurrence of salt in Queensland, more especially to the deposits in the vicinity of the Mulligan River.

13. **Diatomaceous Earth.**—Although this mineral has been found at various localities in New South Wales, the deposits have not been worked commercially on any considerable scale. The output in 1923 was 515 tons, valued at £1,098, of which 327 tons were raised in the Coonabarabran division, 40 tons in the Cooma division, 147 tons in the Barraba division, and a small quantity in the Lismore division. Part of the product was used as a filtering medium in the manufacture of gelatine, and part for the manufacture of metal polish in powdered and liquid form. In Victoria there is a remarkably pure deposit at Lillicur, near Talbot, while beds of the mineral are also met with at other places in the Loddon Valley, near Ballarat, at various places close to Melbourne, at Craigieburn, Lancefield, Portland, Swan Hill, Bacchus Marsh, etc. During 1920, a production of 1,000 tons, valued at £5,000, was recorded, but no production was returned for 1921 to 1923. Fairly extensive deposits of diatomite exist in Queensland, in the Nerang, Beaudesert and Canungar areas, but the various

outcrops have as yet been only partly examined. In Tasmania a deposit of diatomaceous earth has been located at Oatlands, but its use for the manufacture of explosives is apparently prejudiced by the circumstance that the diatoms are pulverized and contaminated with clay.

§ 14. Gems and Gemstones.

1. **Diamonds.**—It is difficult to secure accurate returns in connexion with the production of precious stones, but the yield of diamonds in 1923 in New South Wales was estimated at 175 carats, valued at £230, while the total production to the end of 1923 is given at 202,000 carats, valued at £144,000. The yield in 1923 was obtained at Copeton in the Tingha division. Small quantities of diamonds are found in Victoria in the gravels of streams running through granite country in the Beechworth district, at Kongbool in the Western District, and near Benalla. The stones are generally small, and the production up to date has been trifling. In 1912, eleven small diamonds, valued at £20, were picked out of the sluice boxes of the Great Southern alluvial mine at Rutherglen. A few small diamonds have been found in the Pilbara district in Western Australia. In South Australia diamonds have been found on the Echunga goldfield, the most notable gem being Glover's diamond, which was sold for £70. A few small diamonds have, from time to time, been found in Tasmania, chiefly while sluicing for gold in the Donaldson district.

2. **Sapphires.**—The production of sapphires in New South Wales during 1923 was returned as 1,034 ozs., valued at £3,282, obtained in the Inverell division. A fair quantity of machine stones, zircon and corundum, was also raised, but no sales thereof were effected.

In Queensland, sapphires to the value of £23,309 were obtained in 1923 on the Anakie mineral field. Owing to the unsatisfactory condition of the market, the Government in 1923 continued to afford relief to the miners by making advances up to 95 per cent. of the value of the gems won, and by arranging for the disposal of the more valuable stones overseas. An expert was appointed to take charge of the marketing of the gems in London and on the Continent. Fancy stones occasionally bring high prices, and a yellow sapphire weighing 6½ dwt. found at Iguana Flat was purchased for £100. There is a lapidary on the Anakie field, but many stones are sent away for cutting.

Sapphires are plentifully found in the tin drifts of the Ringarooma and Portland districts in Tasmania, but the stones are, as a rule, small and not worth saving.

3. **Precious Opal.**—The estimated value of the opal won in New South Wales during the year 1923 was £3,040, compared with £15,150 in the preceding year. Practically the whole of the yield came from the Lightning Ridge field, near Walgett, only £40 worth being won at White Cliffs. Operations during 1923 were greatly hampered by the prevailing dry weather. Some very fine stones are at times obtained, one weighing 5 ozs. and valued at £300 being recovered in 1911. Occasionally, black opals of very fine quality are found, one specimen from the Wallangulla field, weighing 6½ carats, being sold in 1910 for £102, while in the early part of 1920 a specimen realized £600. It is stated that this locality is the only place in the world where the "black" variety of the gem has been found. The total value of opal won in New South Wales since the year 1890 is estimated at £1,529,000.

Small quantities of precious opal are found in the Beechworth district in Victoria.

The opaliferous district in Queensland stretches over a considerable area of the western interior of the State, from Kynuna and Opalton as far down as Cunnamulla. The yield in 1923 was estimated at £500, and up to the end of that year at about £181,000. These figures are, however, merely approximations, as large quantities of opal, of which no record is obtained, are disposed of privately. At present the industry, which is not followed by practical miners, suffers from the peculiar disability that in good seasons there is plenty of work available on the pastoral stations, and most men prefer this to the uncertain results obtainable by fossicking, while in dry seasons, when constant work is not obtainable, the search for opal is blocked by the absence of grass and water on the fields.

Owing to difficulty in disposing of the product, little mining was carried on in 1922 and 1923 at the Stuart's Range opal field in South Australia, and no production was recorded. The field is extremely prolific, and only a small portion of the known opal-bearing area has been tested. A fine collection of gems from this field was dispatched to the British Empire Exhibition.

According to a report a few years ago by the Australian Trade Commissioner in the East there is a good sale for the gems in China. It is stated that there is no difficulty in cutting and polishing, as the Chinese method of dealing with jade, dating back many centuries, can also be applied to opal.

4. **Other Gems.**—Various other gems and precious stones have from time to time been discovered in the different States, the list including agates, amethysts, beryls, chiastolite, emeralds, garnets, olivines, moonstones, rubies, topazes, tourmalines, turquoises, and zircons.

§ 15. Numbers Engaged, Wages Paid, and Accidents in Mining.

1. *Total Employment in Mining.*—The number of persons engaged in the mining industry in Australia fluctuates according to the season, the price of industrial metals, the state of the labour markets, and according also to the permanence of new finds, and the development of the established mines. During the year 1923 the number so employed was as follows :—

NUMBER OF PERSONS ENGAGED IN MINING, 1923.

State.	Number of Persons Engaged in Mining for						Total.
	Gold.	Silver, Lead, and Zinc.	Copper.	Tin.	Coal and Shale.	Other.	
New South Wales ..	1,141	5,155	85	1,047	22,989	2,279	32,696
Victoria	2,982	..	..	7	2,131	143	5,263
Queensland	603	133	1,176	703	2,662	499	5,776
South Australia	32	..	420	..	..	693	1,145
Western Australia ..	5,555	96	80	35	713	18	6,497
Tasmania	119	510	1,066	842	318	307	3,162
Northern Territory ..	30	..	3	170	..	27	230
Australia .. .	10,462	5,894	2,830	2,804	28,813	3,966	54,769

The following table shows the number of persons engaged in mining in Australia during each of the years 1891, 1901, and 1923, together with the proportion of the total population so engaged. The general falling-off since 1901 is due to the stagnation caused by the war, the low price of industrial metals, and largely also to the decline in the gold-mining industry :—

NUMBER ENGAGED IN MINING PER 100,000 OF POPULATION, 1891, 1901, AND 1923.

State.	1891.		1901.		1923.	
	Miners Employed.	No. per 100,000 of Population.	Miners Employed.	No. per 100,000 of Population.	Miners Employed.	No. per 100,000 of Population.
New South Wales	30,604	2,700	36,615	2,685	32,696	1,519
Victoria	24,649	2,151	28,670	2,381	5,253	334
Queensland	11,627	2,934	13,352	2,664	5,776	740
South Australia	2,683	834	7,007	1,931	1,145	226
Western Australia	1,269	2,496	20,895	11,087	6,497	1,913
Tasmania	3,988	2,695	6,923	4,017	3,162	1,472
Northern Territory ..	..	..	..	..	230	6,296
Australia	74,820	2,341	113,462	2,992	54,759	983

2. Wages Paid in Mining.—Information regarding rates of wages paid in the mining industry, which in earlier issues of the Year Book was given in this chapter, is now contained in the Labour Report issued by this Bureau.

3. Accidents in Mining, 1923.—The following table gives particulars of the number of men killed and injured in mining accidents during the year 1923 :—

MINING ACCIDENTS, 1923.

Mining for—	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T.	Australia.
			KILLED.					
Coal and shale	31	1	2	..	..	1	..	35
Copper ..	..	..	4	..	..	1	..	5
Gold ..	2	1	..	..	10	..	..	13
Silver, lead, and zinc ..	1	..	1	..	1	..	..	3
Tin	2	..	..	..	..	..	..	2
Other minerals	1	..	..	2	..	..	..	3
Total ..	37	2	7	2	11	2	..	61
			INJURED.					
Coal and shale	101	11	11	..	62	3	..	188
Copper ..	..	..	24	1	..	17	..	42
Gold ..	1	6	4	..	241	..	..	252
Silver, lead, and zinc ..	46	..	5	..	4	5	..	60
Tin	..	..	..	..	..	8	..	8
Other minerals	1	..	..	6	..	..	..	7
Total ..	149	17	44	7	307	33	..	557

The number killed in mining accidents in 1923 was considerably less than that for 1921 when 132 deaths were recorded, the figures being swollen by the 75 fatalities in the Colliery disaster at Mount Mulligan in Queensland.

§ 16. State Aid to Mining.

1. Introduction.—The terms and conditions under which the States granted aid to mining were alluded to at some length in previous issues (see Year Books 4 and 5), but owing to considerations of space they have been omitted from this issue. A résumé of what is being done in this direction at the present time is given hereunder.

2. New South Wales.—The chief aid given in this State is in the direction of assistance to prospectors. Up to the end of 1923 the total sum expended in this manner amounted to £542,049, of which £9,574 was advanced in 1923. A sum of £1,000 was made available during the year for the purpose of assisting in the erection of crushing batteries or reduction plants, and an advance of £500 made therefrom. The reward for the discovery of new mineral fields within the State has been increased from £500 to £1,000, with provision for sums of £200 and £500 in respect of fields not large enough to qualify for the full amount, and the conditions have been made more liberal.

3. **Victoria.**—Since the passage of the Mining Development Act in 1897, the expenditure under its varying provisions has been £1,178,871, of which £281,000 was disbursed in connexion with advances to companies, £313,000 on boring, £244,000 on mining enterprise, £101,000 on advances to miners, £93,000 on maintenance, removal, etc., of batteries, and about £95,000 in connexion with the State brown coal mine. The expenditure for the financial year 1923–24 amounted to about £68,000, of which £46,000 was incurred in connexion with the State brown coal mine, and £11,000 was spent on boring.

4. **Queensland.**—State assistance to the mining industry in 1923 amounted to £13,106, of which £3,067 consisted of loans in aid of deep sinking; £8,742 grants in aid of prospecting, and £1,297 in aid of roads and bridges to gold and mineral fields and water supply. In addition, a sum of £86,812 was expended from loans on Chillagoe and the Mt. Mulligan mine.

During the year the Chillagoe State Smelters produced 1,715 tons of lead and 491 tons of copper, the gold and silver contents of which amounted to 1,553 oz., and 179,480 oz. respectively. The State Arsenic Works at Jibbinbar produced 340 tons of high-grade arsenic. Tin, wolfram, and molybdenite are treated at the State Battery at Bamford, which, on account of low prices, was not in operation during 1923. About 700 tons of ore and 300 tons of tailings were treated by the State Battery at Charters Towers. A new State battery was completed in 1922 at Kidston on the Etheridge gold-field and during 1923 treated 2,611 tons of ore for a yield of 880 oz. gold and 27 tons of concentrates. The State Assay Office at Cloncurry made over 2,400 assays for the public during the year.

5. **South Australia.**—Aid is given to the mining industry under the terms of the Mining Act of 1893, and previous measures. Up to the end of 1923 the total amount of subsidy paid was £65,163, of which £13,227 has been repaid, and £2,250 written off, leaving a debit of £49,686. Portion of this amount is represented by machinery that has fallen into the hands of the Government. Repayments must be provided from profits, but in only two instances have the profits enabled a full return to be made.

6. **Western Australia.**—Under the Mining Development Act of 1902 assistance was granted in 1923 in accordance with the subjoined statement:—Advances in aid of mining work and equipment of mines with machinery, £33,914; aid to prospectors, £6,306; advances in aid of boring, £759; subsidies paid on stone crushed for the public, £256; making a total of £41,235. In addition, a sum of £14,061 was expended on various matters such as water supply, assistance in carting ore for long distances, aid in developmental work below the 100 feet level in small mines, and rebates to prospectors working low-grade mines. The receipts under the Act, exclusive of interest payments, came to £3,262, of which £1,664 consisted of refunds of advances.

In 1923 there were 29 State batteries in operation. The amount expended thereon up to the end of 1923 was £91,981 from revenue and £305,608 from loan, giving a total of £397,589. During the year receipts amounted to £28,335, and working expenditure to £38,408. The total value of gold and tin recovered to the end of 1923 at the State plants was £5,768,930, resulting from the treatment of 1,384,000 tons of gold ore and 80,000 tons of tin ore, together with a small amount from residues.

7. **Tasmania.**—During the year 1923, the sum of £1,887 was expended in aid to mining, including £520 for salaries, £91 for assay material, £328 assistance to prospectors, and advance of £352 to the No. 6 Argent Mining Company. The receipts amounted to £2,568, of which £1,967 represented royalty by tributers.

Tributers' surveys and assays are made free of charge by the Assay and Survey Office at Zeehan.

8. **Northern Territory.**—During the year 1922–23 Government assistance to prospecting parties amounted to £304, while in some cases help in the form of free use of horses and plant was granted. There were no subsidies for underground mining.

The Government maintains a battery at Marranboy, and the Government Assayer makes free assays for prospectors, and arranges for the sampling, storage, and sale of ores.

§ 17. Commonwealth Government Control of Industrial Metals.

The proclamation under the Customs Act prohibiting the exportation of metals without the consent of the Minister for Trade and Customs is still in force, but consent is granted in every case where the contract relating to the sale of the metals has been approved.

§ 18. Metallic Contents of Ores, etc., Produced and Exported.

1. **Local Production.**—According to returns compiled by the Secretary of the Australian Metal Exchange from information obtained from mining companies and metal smelting and refining works, the quantities of the principal metals (exclusive of gold) extracted in Australia during the five years 1920 to 1924 were as follows :—

REFINED METALS PRODUCED IN AUSTRALIA, 1920 TO 1924.

Metal.		1920.	1921.	1922.	1923.	1924.
Silver	ozs.	681,370	4,572,878	7,896,052	7,645,689	7,631,213
Lead, pig ..	tons	4,077	55,749	105,528	118,513	126,625
Zinc	tons	9,665	1,681	23,724	41,153	46,372
Copper	tons	24,069	18,600	11,524	17,825	14,100
Tin	tons	4,108	2,985	2,657	2,201	1,926

2. *Metallic Contents of Ores, Concentrates, etc., Exported.*—The estimated metallic contents of ores, concentrates, etc., exported during the five years 1920 to 1924 are given in the following table :—

METALLIC CONTENTS OF ORES, CONCENTRATES, ETC., EXPORTED, 1920 TO 1924.

Metal.		Contained in—	1920.	1921.	1922.	1923.	1924.
Silver	ozs.	Lead—Silver—Gold Bullion	141,263	64,811	165,290	283,453	158,361
		Lead Concentrates ..	..	210,944	281,728	1,298,750	90,360
		Zinc Concentrates ..	522,515	456,317	3,390,064	3,526,774	1,941,507
		Copper Ores	..	..	12,261	1,378	51,942
		Total	663,778	732,072	3,850,243	5,110,355	2,242,170
Lead	tons	Lead—Silver—Gold Bullion	1,939	580	1,790	3,564	1,808
		Lead Concentrates ..	4,122	3,950	2,959	18,572	4,852
		Zinc Concentrates ..	3,170	2,498	19,910	425	19,859
		Total	9,231	7,028	24,659	22,561	26,519
Zinc	tons	Lead Concentrates ..	..	435	..	..	384
		Zinc Concentrates ..	24,242	19,181	135,690	146,693	122,305
		Total	24,242	19,616	135,690	146,693	122,689
Copper	tons	Ores, Matte, etc. ..	2,117	34	326	2,182	875
Tin	tons	Concentrates	70	5	..	..	4

§ 19. Oversea Exports of Ores, Metals, etc.

The following table shows the quantity and value of the principal oversea exports of ores, concentrates, and metals, the produce of Australia, together with the countries to which the respective products were forwarded, for the year 1923–24 :—

OVERSEA EXPORTS OF AUSTRALIAN ORES, METALS, ETC., 1923-24.

Article.	Total Exports.	Exports to—						
		United Kingdom.	United States.	Belgium.	Germany.	Japan.	New Zealand.	Other Countries.
QUANTITY.								
Ores—	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.
Alunite	32,860	32,860	..	..	..	..	..	..
Antimony ..	8,695	6,700	1,995	..	..	..	..	..
Cobalt	22,531	22,331	200	..	..	..	..	..
Silver and Silver-lead	108,772	185	..	53,572	55,015	..	..	..
Concentrates—								
Silver and Silver-lead	627,814	41,817	..	31,933	261,163	..	..	(h)292,901
Zinc	5,410,461	1,464,491	..	3,617,982	126,401	194	..	(b)201,393
Copper—								
Matte	23,389	20,137	..	..	3,252	..	..	..
Ingot	116,029	77,285	18,405	..	2,500	..	2,359	(c)15,480
Tin—Ingot	40,041	25,077	10,580	..	100	..	4,232	52
Lead—								
Matte	83,525	83,525	..	..	..	..	..	..
Pig	2,116,330	1,618,828	..	9,987	57,111	293,301	58,282	(d)78,821
Zinc—Bars, Blocks, etc.	638,516	213,282	..	..	59,993	296,775	368	(g)68,098
Iron—Pig	2,738	..	..	..	..	..	558	(f)2,180
	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.
Platinum, Osmium, etc.	1,101	636	355	..	..	..	..	(b)110
Gold—								
Matte	3,411	3,411	..	..	..	..	..	..
Bar, Dust, etc. ..	91,008	651	..	..	..	..	..	(a)90,357
Silver—								
Matte	447,001	437,000	..	..	..	..	..	(e)10,001
Bar, Ingot, etc. ..	7,111,964	652,184	..	..	..	..	3,428	(i)6,456,352
VALUE—£.								
Ores—								
Alunite	6,572	6,572	..	..	..	..	..	..
Antimony ..	9,482	7,326	2,156	..	..	..	..	..
Cobalt	57,152	56,497	655	..	..	..	..	..
Silver and Silver-lead	118,515	140	..	63,640	54,735	..	..	..
Concentrates—								
Silver and Silver-lead	441,075	34,216	..	22,060	182,625	..	..	(h)202,174
Zinc	1,160,472	321,882	..	764,750	27,370	52	..	(b)46,418
Copper—								
Matte	74,737	70,050	..	..	4,687	..	..	..
Ingot	392,187	267,436	56,393	..	8,500	..	8,462	(c)51,396
Tin—Ingot	447,757	276,068	122,651	..	995	..	47,418	625
Lead—								
Matte	124,678	..	..	..	..	..	..	..
Pig	3,198,785	2,465,196	..	16,979	84,495	419,988	95,894	(d)116,233
Zinc—Bars, Blocks, etc.	1,057,895	357,808	..	..	105,850	479,194	813	(g)114,140
Iron—Pig	1,097	..	..	..	..	..	258	(f)839
Platinum, Osmium, etc.	29,198	15,371	10,141	..	..	..	..	(b)3,686
Gold—								
Matte	15,003	15,003	..	..	..	..	..	..
Bar, Dust, etc. ..	385,738	2,977	..	..	..	..	..	(a)382,761
Silver—								
Matte	65,643	64,323	..	..	..	..	..	(e)1,320
Bar, Ingot, etc. ..	997,874	101,835	..	..	..	..	482	(i)895,557

(a) Ceylon, 63,492 oz., £268,646; China, 26,865 oz., £114,115. (b) France. (c) India. (d) Principally China and Hong Kong. (e) Ceylon, 9,001 oz., £1,170. (f) Principally South African Union. (g) India, 1,100 cwt., £2,090; France, 60,998 cwt., £101,550; Italy, 6,000 cwt., £10,500. (h) Spain. (i) Ceylon, 97,610 oz., £13,146; India, 4,328,319 oz., £638,029; Pacific Islands, 5,350 oz., £881; China, 2,025,073 oz., £243,501.