

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 Strzelecki 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 1921.*—The quantities (where available) and the values of the principal minerals produced in each State, and in Australia as a whole during the year 1921, 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, 1921.

Minerals.	Unit.	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T. (a)	Australia.
Alunite ..	ton	520	..	..	15	..	..	..	535
Antimony ore ..	..	125	347	..	..	..	..	..	472
Arsenic ..	..	397	..	220	..	7	..	..	624
Asbestos ..	..	945	..	..	2	235	..	..	1,182
Barytes ..	..	200	..	..	1,269	1	..	..	1,470
Bismuth ..	cwt.	160	..	1	..	..	1	..	162
Brown coal ..	ton	..	79,224	..	..	..	..	..	79,224
Chromite ..	..	62	..	..	..	..	..	..	62
Coal ..	..	10,793,387	514,859	954,763	..	468,817	66,476	..	12,798,302
Cobalt ..	..	..	..	85	..	..	..	..	85
Copper (ingot and matte) ..	..	499	..	2,428	1,532	206	6,181	..	10,846
Copper ore ..	..	..	..	..	..	1,040	..	..	1,040
Diatomaceous earth ..	..	206	..	..	..	..	..	..	206
Gold ..	fine oz.	51,173	104,512	40,376	2,628	553,731	5,340	245	758,005
Gypsum ..	ton	300	11,139	..	34,383	664	..	..	46,486
Iron (pig) (c) ..	..	90,033	..	..	..	..	..	..	90,033
Iron oxide ..	..	3,109	..	..	..	..	..	..	3,109
Ironstone ..	..	7,473	..	4,061	506,993	..	..	..	518,527
Kaolin ..	..	2,386	2,142	..	..	..	..	..	4,528
Lead ..	..	20,353	..	1,057	..	2,156	1,435	..	25,001
Lead and silver ore, concentrates, etc. ..	..	53,507	..	..	..	..	..	..	53,507
Limestone flux ..	..	111,558	..	63,275	44,277	..	..	..	219,110
Magnetite ..	..	12,268	128	..	172	..	..	..	12,568
Manganese ore ..	..	3,515	10	833	1,596	16	..	..	5,970
Molybdenite ..	cwt.	..	100	175	..	..	..	..	275
Osmiridium ..	oz.	..	..	..	..	..	1,751	..	1,751
Phosphate ..	ton	200	1,541	369	5,079	..	..	..	7,189
Pigments ..	..	443	335	..	197	..	15	..	990
Platinum ..	oz.	249	..	..	..	..	..	..	249
Pyritic ore ..	ton	2,000	..	..	..	6,117	607	..	8,724
Salt ..	..	..	(b)	..	56,492	..	..	..	56,492
Shale (oil) ..	..	32,489	..	..	..	..	868	..	33,357
Silver ..	fine oz.	1,963,379	5,204	195,328	1,449	116,151	348,658	..	2,630,169
Tin and tin ore ..	ton	1,595	80	1,050	..	67	790	83	3,665
Wolfram ..	..	..	..	5	..	..	10	102	117
Zinc ores and concentrates ..	..	79,694	..	..	..	..	..	..	79,694

(a) Year ended 30th June, 1921.

(b) Not available for publication.

(c) See letterpress preceding this table.

The comparative value of the minerals raised in each State during 1921 is given in the following table :—

MINERAL PRODUCTION.—VALUE, 1921.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T. (b)	Australia.
	£	£	£	£	£	£	£	£
Alunite ..	2,080	..	..	60	..	..	..	2,140
Antimony ore ..	900	5,890	..	..	..	..	..	6,790
Arsenic ..	17,865	..	12,325	..	16	..	..	30,206
Asbestos ..	23,736	..	..	71	13,581	..	..	37,588
Barytes ..	600	..	..	4,465	18	..	..	5,083
Bismuth ..	912	..	21	..	..	21	..	954
Brown coal ..	..	31,074	..	..	..	..	..	31,074
Chromite ..	124	..	..	..	..	..	..	124
Coal ..	9,078,388	603,323	831,483	..	407,117	63,446	..	10,983,757
Cobalt ..	..	..	21,332	..	..	..	..	21,332
Copper (ingot and matte) ..	41,267	..	168,556	106,370	8,448	463,163	..	787,804
Copper ore ..	..	..	..	..	16,153	..	..	16,153
Diamonds ..	1,915	..	..	..	..	..	..	1,915
Diatomaceous earth ..	684	..	..	..	..	..	..	684
Gold ..	271,302	554,087	214,060	13,933	2,935,693	28,311	1,299	4,018,685
Gypsum ..	210	6,914	..	29,427	622	..	..	37,173
Iron (pig) (c) ..	639,376	..	..	..	..	..	..	639,376
Iron oxide ..	2,917	..	..	..	..	..	..	2,917
Ironstone ..	9,132	..	5,976	587,267	..	..	..	602,375
Kaolin ..	1,790	1,577	..	..	..	..	..	3,367
Lead ..	462,862	..	24,077	..	48,863	32,241	..	568,043
Lead and silver-lead ore, concentrates, etc. ..	539,339	..	..	..	..	..	..	539,339

MINERAL PRODUCTION VALUE, 1921—*continued*.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T. (b)	Australia.
	£	£	£	£	£	£	£	£
Limestone flux ..	41,834	..	31,518	15,546	..	..	..	88,898
Magnesite ..	14,407	384	..	373	..	..	..	15,164
Manganese ore ..	10,545	100	4,710	9,774	145	..	..	25,274
Molybdenite ..	..	70	2,187	..	..	..	..	2,257
Opal ..	13,020	..	500	..	..	..	..	13,520
Osmiridium ..	..	..	..	..	..	42,035	..	42,935
Phosphate ..	50	1,541	1,570	6,203	..	..	..	9,304
Platinum ..	3,441	..	..	..	..	..	..	3,441
Pyritic ore ..	6,000	..	..	..	7,871	2,579	..	16,450
Pigments ..	544	375	..	1,328	..	56	..	2,303
Salt ..	..	(a)	..	127,107	..	..	..	127,107
Sapphires ..	2,976	..	46,524	..	..	..	..	49,500
Shale (oil) ..	77,380	..	..	..	..	1,506	..	78,886
Silver ..	325,163	862	30,111	240	18,658	57,576	..	432,610
Tin and tin ore ..	163,451	11,961	98,471	..	6,485	130,257	7,793	418,418
Wolfram ..	..	..	280	..	..	676	9,752	10,708
Zinc concentrates	283,455	..	..	..	..	..	..	283,455
Unenumerated ..	14,944	625	2,198	2,495	94	..	159	20,515
Total ..	12,052,509	1,218,783	1,495,899	904,659	3,463,764	822,767	19,003	19,977,384

(a) Not available for publication. (b) Year ended 30th June, 1921. (c) See letterpress page 791.

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 1921 consist of—lime, £84,050; marble, £2,100; Portland cement, £838,534; coke, £1,029,694, and brick and pottery clays £37,250. From the Queensland returns, marble, £3,093 has been deducted, and from South Australia, sulphuric acid, £660.

4. Value of Production, 1917 to 1921.—The value of the mineral production in each State during the five years 1917 to 1921 is given in the table hereunder:—

MINERAL PRODUCTION.—VALUE, 1917 TO 1921.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T.	Australia.
	£	£	£	£	£	£	£	£
1917 ..	11,970,388	1,294,240	4,012,977	1,451,854	4,629,027	1,582,322	56,903	24,997,711
1918 ..	13,220,135	1,102,652	3,740,925	1,441,885	4,265,577	1,597,694	92,730	25,461,598
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

The heavy fall noticeable in 1919 in New South Wales 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. Copper returns for 1921 in South Australia were the lowest recorded since 1854, but there were increases in ironstone, manganese, gold, and silver. In Western Australia the gold yield in 1921 again showed a decline, being upwards of £539,000 less than in 1920. The returns for lead and silver fell away by nearly £123,000, while the value of tin exported decreased by nearly £43,000. High cost of production, coupled with low market prices for base metals are stated to be chiefly responsible for the decline. It was proposed to send out a well-equipped prospecting expedition early in 1922 to systematically examine a defined area where reports indicate the possibility of the existence of payable minerals. 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. The stagnation in the base metal industry is reflected in the Northern Territory returns for 1921. In the preceding year wolfram to the value of about £46,000 was produced, whereas less than £10,000 worth was recorded in 1921, while the production of tin declined from £28,000 in 1920 to about £8,000 in 1921.

5. **Total Production to end of 1921.**—In the next table will be found the estimated value of the total mineral production in each State up to the end of 1921. 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 £15,471,000 of that published by the State Department of Mines, the principal items excluded being coke, £6,874,000, cement, £6,215,000; lime, £756,000; and marble, £43,000.

MINERAL PRODUCTION.—VALUE TO END OF 1921.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor.Ter.(a)	Australia.
	£	£	£	£	£	£	£	Million. £
Gold ..	63,251,172	301,431,486	84,159,679	1,608,488	147,771,481	8,821,826	2,274,174	609
Silver and lead ..	89,340,109	261,040	3,247,724	377,921	1,770,863	6,963,701	62,515	102
Copper ..	15,297,345	216,656	24,307,144	32,709,458	1,660,643	16,048,518	231,710	91
Iron ..	4,146,918	15,641	471,784	2,888,057	36,712	52,110	..	8
Tin ..	12,505,748	903,544	9,900,890	..	1,484,041	15,218,996	520,189	40
Wolfram ..	271,642	11,885	1,061,321	301	1,441	172,293	216,281	2
Zinc ..	13,727,456	..	..	15,993	5,437	36,320	..	14
Coal ..	114,946,008	5,802,051	10,452,980	..	3,081,374	1,075,719	..	135
Other ..	6,881,164	678,415	2,272,429	2,223,195	101,262	546,412	28,438	13
Total..	320,367,562	309,320,718	135,873,961	39,823,413	155,913,254	48,935,895	3,333,307	1,014

(a) To 30th June, 1921.

The "other" minerals in New South Wales include alunite, £195,587; antimony, £344,588; bismuth, £223,840; chrome, £113,425; diamonds, £142,184; limestone flux, £927,392; molybdenite, £214,007; opal, £1,511,204; scheelite, £192,375; and oil shale, £2,625,875. In the Victorian returns antimony ore was responsible for £555,055. The value for coal in this State includes £186,974 for brown coal. Included in "other" in the Queensland production were opal, £180,195; gems, £502,126; bismuth, £308,749; molybdenite, £404,452; and limestone flux, £636,070. The chief items in South Australian "other" minerals were salt, £1,386,146; limestone flux, £226,632; gypsum, £199,172; and phosphate, £123,589. In the Tasmanian returns limestone flux was responsible for £91,739, and osmiridium for £242,426, 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 1921, 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 1921.

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..	13,076,103	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	5,581,701	141,876	13,250	9,376,573
1914 ..	528,873	1,755,236	1,059,674	26,581	5,237,353	111,475	9,754	8,728,946
1915 ..	562,819	1,397,793	1,060,703	25,830	5,140,228	78,784	3,781	8,269,938
1916 ..	459,370	1,090,194	913,951	33,000	4,508,532	67,072	3,861	7,075,980
1917 ..	349,038	857,500	761,639	30,334	4,121,645	61,577	3,677	6,185,410
1918 ..	369,743	674,655	567,371	26,252	3,723,183	44,724	2,229	5,408,157
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	3,475,392	35,134	5,282	5,308,092
1921 ..	271,302	554,087	214,060	13,933	2,935,693	28,311	1,299	4,018,685
Total ..	63,251,172	301,431,486	84,159,679	1,608,488	147,771,481	8,821,826	2,274,174	609,318,306

The value of the gold yield in 1921 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 £4 4s. 11½d. in 1917 and 1918, at £5 2s. 1½d. in 1919, at £5 12s. 6d. in 1920, and at £5 6s. 0½d. in 1921.

GOLD.—QUANTITY PRODUCED, 1917 TO 1921.

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.
1917 ..	82,170	201,873	179,305	7,141	970,318	14,496	(a) 866	1,456,169
1918 ..	87,045	158,827	133,570	6,180	876,512	10,529	(a) 525	1,273,188
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

(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. New South Wales and South Australia showed some improvement on the totals for 1920, but there were heavy falls in other States, especially in Queensland, where the low yield was due to the suspension of operations at Mount Morgan over the greater part of the year.

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 maintained this pre-eminence to the end of 1920. 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, 1912 TO 1921.

State.	Annual Average of Gold Production, 1912 to 1921.	Percentage on Total.	State.	Annual Average of Gold Production, 1912 to 1921.	Percentage on Total.
	Ozs.			Ozs.	
Total ..	1,569,983	100.0	New South Wales	101,524	6.5
Western Australia ..	985,366	62.8	Tasmania ..	17,625	1.1
Victoria ..	266,743	17.0	South Australia ..	5,412	0.3
Queensland ..	191,753	12.2	Northern Territory	1,560	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 1,598 ozs. in 1921, the chief yields being—Hill End (Tambaroora and Turon District) 222 ozs.; Major's Creek (Southern District) 166 ozs.; Armidale (Peel and Uralla) 108 ozs.; and Windeyer (Mudgee) 100 ozs. The quantity obtained by dredging was 13,191 ozs.; the largest returns being obtained at Adelong (Tumut and Adelong District) 5,859 ozs.; Gundagai (Lachlan) 4,215 ozs.; Araluen (Southern) 1,631 ozs.; and Wellington (Mudgee) 1,200 ozs. During 1921 there were 11 bucket dredges and 1 pump dredge in operation, their combined value being £81,478. The quantity of gold won from quartz amounted to £19,882 ozs. At the present time the Cobar district is the chief centre of the production from quartz, the yields from the Cobar and Canbelego fields included therein being respectively 676 ozs. and 8,685 ozs. Next in order were Hill End, 2,016 ozs.; Cootamundra, 1,763 ozs.; Hillgrove, 1,346 ozs.; and Carcoar, 1,052 ozs.

(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 fifteen years, and the return for 1921 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 Morro Velho belonging to the St. John del Ray Mining Co., in the State of Minas, Brazil, where the workings reach a vertical depth of 6,426 feet from the surface. One mine in South Africa is 5,900 feet deep, while two shafts on the Kolar goldfield in India reach 5,419 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 last year, were as follows:—Ararat and Stawell, 4,722 and 168; Ballarat, 1,557 and 6,080; Beechworth, 11,149 and 19,331; Bendigo, 988 and 61,105; Castlemaine, 2,820 and 2,998; Gippsland, 2,285 and 548; Maryborough 748 and 380.

The largest output from quartz mining in the Bendigo district was furnished by the New Red, White, and Blue, with 9,237 ozs., value at £42,292; followed by the Carlisle, 7,445 ozs., £31,074; Constellation, 6,174 ozs., £28,504; Carlisle-Unity, 3,841 ozs., £20,464, and Hercules and Energetic, 2,917 ozs., £13,641. In the Beechworth district the Morning Star Co., at Wood's Point, returned 10,977 ozs., valued at £36,336; the Rose, Thistle and Shamrock at Harrietville, 3,215 ozs., £12,859; and the A.I. Gold Mines at Gaffney's Creek, 2,931 ozs., £12,480.

From alluvial the principal yield was obtained by Cock's Pioneer Gold and Tin Mines, with 5,591 ozs., valued at £23,365. This Company, which operates in the Beechworth district also produced about £11,000 worth of tin during the year. The New Langi Logan and the Langi Logan South at Ararat returned yields valued at £9,420 and £6,508 respectively.

(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 1921 being only 353 ozs., while the quantity produced from stone treated was 20,331 ozs.; from copper and other ores 17,889 ozs.; and from old tailings 1,803 ozs.; making a total production of 40,376 ozs. The yields from the principal fields were—Mount Morgan, 17,494 ozs.; Charters Towers, 6,660 ozs.; Gympie, 6,387 ozs.; Chillagoe, 3,274 ozs.; and Etheridge, 2,402 ozs. As pointed out previously, the cessation of operations at Mount Morgan was chiefly responsible for the very low yield in 1921, the production from this field being less than 18,000 ozs. as compared with nearly 91,000 ozs. in the preceding year.

(iv) *South Australia.* In South Australia alluvial gold was worked for many years in the gullies round Adelaide, while a fair amount of gold has been obtained by this method at Teetulp, in the northern area. The battery and cyanide returns as published in the *Mining Review* show that the chief producing centres in 1921 were Deloraine and Tarcoola.

(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. There were decreases in the tonnage of ore treated on all the fields in 1921 excepting Broad Arrow, North-East Coolgardie, and Phillips River, where small increases were recorded. The yields from the principal fields in order of importance were as follows:—East Coolgardie, 378,430 ozs.; Murchison, 41,257 ozs.; Mt. Margaret, 20,804 ozs.; Yilgarn, 19,242 ozs.; East Murchison, 18,762 ozs.; North Coolgardie, 10,640 ozs. Coolgardie, 9,548 ozs.; Broad Arrow, 8,875 ozs.; Dundas, 5,456 ozs.; and North-East Coolgardie, 4,148 ozs. Of the total yield of 526,000 ozs. reported to the Mines Department, 520,000 ozs. were obtained from ore treated, and about 4,000 ozs., from doliied and specimens while the return from alluvial was a little over 700 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 gold mining companies to the end of the year 1921 exceeded 28 millions.

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 1921 the total had dropped to £2,936,000. 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 1921 were as follows:—North-West and West Coasts, 4,714 ozs.; Mathinna, 568 ozs.; Mt. Cameron, Mt. Victoria, and Warrentinna, 199 ozs.; Beaconsfield, 121 ozs.; and smaller quantities from Mt. Claude, Lefroy, and Lisle Golconda. The New Golden Gate Mine at Mathinna is now practically the only gold mine in operation in the State.

The total production was equal to 5,340 ozs. fine. During 1921 the blister copper produced by the Mt. Lyell Mining and Railway Co. Ltd. contained approximately 4,646 ozs. of gold.

(vii) *Northern Territory*. The production for 1921 amounted to only 245 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. Including Chinese, only 10 miners were engaged in the search for gold in 1921.

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 1917 to 1921. 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, 1917 TO 1921.

Year.				World's Production of Gold.	Gold Produced in Australia.	Percentage of Australia on Total.
				£	£	%
1917	..	..	..	87,734,000	6,185,000	7.05
1918	..	..	..	77,306,000	5,408,000	7.00
1919	..	..	..	89,723,000	5,454,000	6.08
1920	..	..	..	90,076,000	5,305,000	5.89
1921	..	..	..	83,069,000	4,018,000	4.84

The value of the gold yield in the ten chief producing countries during each of the five years 1917 to 1921 is given in the table hereunder. Particulars of the quantity and value of the gold production for all countries for the ten years 1912-21 will be found in the Bulletin of Australian Production issued by this Bureau.

GOLD.—PRODUCTION, CHIEF COUNTRIES, 1917 TO 1921.

Country.	1917.	1918.	1919.	1920.	1921.
	£	£	£	£	£
Transvaal	38,306,000	35,759,000	42,548,000	45,890,000	43,096,000
United States	16,912,000	13,841,000	14,695,000	13,581,000	12,519,000
Canada	3,138,000	2,972,000	3,916,000	4,303,000	4,911,000
Australia	6,185,000	5,408,000	5,454,000	5,305,000	4,018,000
Mexico	3,215,000	3,457,000	3,873,000	4,154,000	3,626,000
Rhodesia	3,544,000	2,682,000	3,030,000	3,108,000	3,104,000
India	2,222,000	2,060,000	2,304,000	2,609,000	2,073,000
Colombia	1,031,000	959,000	1,482,000	1,578,000	1,539,000
Japan	1,185,000	1,159,000	1,246,000	1,337,000	1,281,000
Gold Coast	1,549,000	1,338,000	1,508,000	1,167,000	1,078,000

For the first two years given in the above table the values quoted are based on a fine ounce value of £4 4s. 11 $\frac{1}{2}$ d. For the last three years, however, it has been deemed advisable to apportion values in accordance with Australian currency, i.e. at £5 2s. 1 $\frac{1}{2}$ d. for 1919, £5 12s. 6d. for 1920, and £5 6s. 0 $\frac{3}{4}$ d. for 1921.

The next table shows the average yearly value in order of importance of the yield in the chief gold-producing countries for the decennium 1912-21 :—

GOLD.—AVERAGE ANNUAL PRODUCTION, CHIEF COUNTRIES, 1912 TO 1921.

Country.	Value.	Country.	Value.
	£		£
Transvaal	39,543,000	Mexico	3,022,000
United States	16,718,000	India	2,284,000
Australia	6,970,000	Gold Coast	1,488,000
Russia	3,672,000	Colombia	1,199,000
Canada	3,639,000	Japan	1,180,000
Rhodesia	3,260,000	New Zealand	1,037,000

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 1917 TO 1921.

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
1917 ..	1,823	6,069	1,375	150	8,752	155	92	18,416
1918 ..	2,540	3,547	929	100	7,790	125	84	15,115
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

§ 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 1921 amounted to 249 ozs., valued at £3,441, while the total production recorded for the period 1894 to 1921 amounted to 15,938 ozs., valued at £67,847. The old lead is practically exhausted, but vigorous prospecting has taken place in other areas in the division.

(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.

(ii) *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.

§ 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 1921 is given hereunder:—

SILVER AND LEAD.—PRODUCTION, 1917 TO 1921.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.	Australia.
	£	£	£	£	£	£	£	£
1917 ..	5,110,096	1,406	55,181	12,351	178,872	152,122	(a)275	5,510,303
1918 ..	5,739,509	1,319	36,645	10,492	189,636	127,176	(a)200	6,104,977
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

(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, 1917 TO 1921.

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.	£
1917 ..	7,562,286	138,006	4,694	5,765,094	983,693	6,181	48,912	668,934
1918 ..	8,724,018	155,306	5,622	6,744,034	535,943	3,178	21,926	232,210
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	470,221	3,025	21,742	274,061
1921 ..	3,624,413	47,426	(a) 1,425	1,723,864	617,477	6,530	19,272	261,238

(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 was 317,333 tons, of which 316,302 tons were sulphide and 1,031 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 1921.

Mine.	Value of Output to end of 1921.	Dividends and Bonuses Paid to end of 1921.
	£	£
Broken Hill Proprietary Co. Ltd.	48,380,736	12,453,449
Broken Hill Proprietary Block 14 Co. Ltd.	3,922,203	632,160
British Broken Hill Proprietary Co. Ltd.	4,895,825	821,280
Broken Hill Proprietary Block 10 Co. Ltd.	4,926,918	1,432,500
Sulphide Corporation Ltd. (Central Mine)	21,325,964	2,709,375
Broken Hill South Ltd.	10,702,724	2,535,000
North Broken Hill Ltd.	6,731,034	1,978,940
Broken Hill Junction Lead Mining Co.	1,149,800	87,500
Junction North Broken Hill Mine	2,639,679	160,814
The Zinc Corporation Ltd.	2,987,089	10,000
Barrier South Ltd.	151,517	50,000
Totals	107,813,489	22,871,018

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 nearly 114 millions and £7 millions respectively. The authorized capital of the various companies amounted to £7,637,000.

(b) *Yerranderie*. The mines in the Yerranderie division in the Southern Mining District produced 2,912 tons of ore in 1921, yielding 250,000 ozs. of silver, besides 343 ozs. of gold and 552 tons of lead, the total production being valued at £50,574. These figures are about £38,000 lower than in 1920, the decline being due to the low price of lead coupled with the heavy costs of production, transport, and treatment.

(c) *Cobar*. A considerable quantity of silver is obtained from the Great Cobar Mine and attached properties, the production in 1921 amounting to 79,868 ozs.

(d) *Sunny Corner*. In this division of the Bathurst Mining District 1,200 tons of ore were raised, from which 12,800 ozs. of silver and 120 ozs. of gold were produced in 1921.

(e) *Other Areas*. Small quantities were produced during the year in various other areas, but operations were greatly reduced owing to the heavy fall in the prices of silver and lead.

(ii) *Victoria*. The silver produced in 1921 amounted to 5,204 ozs., valued at £862, 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 1921 were as follows :—Chillagoe, silver £14,864, lead £20,070 ; Herberton, silver £3,480, lead £1,366 ; Stanthorpe, silver £4,609 ; Brisbane, silver £2,108, lead £1,929 ; Etheridge, silver £2,089. Lead did not suffer to such an extent as other metals from the fall in prices during 1921, and production was greatest at Mungana in the Chillagoe field, where the Girofla Mine, held on tribute by the State, was the chief centre of activity. The production of silver from the Etheridge and Mount Morgan fields fell off considerably in 1921.

(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. The production of silver and silver-lead ore in 1921 was valued at £240.

(v) *Western Australia*. The quantity of silver obtained as a by-product and exported in 1921 was 116,151 ozs., valued at £18,658. In addition, 2,156 tons of pig lead, valued at £48,863, were exported, but there were no exports during the year of lead and silver lead ore and concentrates. The production of lead ore from the Northampton mineral field amounted in 1921 to 10,330 tons.

(vi) *Tasmania*. The silver produced in 1921 amounted to 348,658 ozs., valued at £57,576, and the lead to 1,435 tons, valued at £32,341. Of the silver, Mt. Lyell returned 183,021 ozs ; the Zeehan Mines, 87,387 ozs ; North Mt. Farrell, 34,402 ozs ; the Magnet Mines, 32,502 ozs ; and Round Hill, 11,346 ozs. The principal producers of lead were the Zeehan Mines, 698 tons ; North Mt. Farrell, 377 tons ; Magnet Mines, 195 tons ; and Round Hill, 165 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 1921.

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

SILVER.—WORLD'S PRODUCTION, 1917 TO 1921.

Total.	1917	1918.	1919.	1920.	1921.
World's production in 1,000 fine ozs	174,188	197,395	176,457	174,612	168,000

The share of Australia in the world's silver production in 1919 was estimated at 7,800,000 ozs., or about $4\frac{1}{2}$ 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. 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 1921 from the chief silver-producing countries were as follows :—

SILVER.—PRODUCTION, CHIEF COUNTRIES, 1921.

Country.	Production.	Country.	Production.
	Fine ozs. (·000 omitted.)		Fine ozs. (·000 omitted.)
United States	62,700	Burma	3,500
Mexico	50,360	Central America ..	2,500
South America	14,000	Dutch East Indies ..	1,100
Australia	5,300	Congo, etc.	200
Japan	5,000	Rhodesia	150
Spain and other European Countries	5,000	China	100

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, 1917 TO 1921.

Price.	1917.	1918.	1919.	1920.	1921.
Pence per standard oz... ..	40 $\frac{7}{8}$	47 $\frac{1}{2}$	57 $\frac{1}{16}$	61 $\frac{9}{16}$	36 $\frac{7}{8}$

The high average in 1917 was succeeded by a further rise to 47 $\frac{1}{2}$ d. in 1918, the monthly averages ranging from 42 $\frac{3}{8}$ d. in February to 49 $\frac{1}{2}$ d. in September and October. Prices in 1919 showed a sensational rise. Beginning with an average of about 48 $\frac{3}{8}$ d. 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 $\frac{7}{8}$ d. in October, and again declining to 35 $\frac{1}{8}$ d. at the end of the year.

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, 1917 TO 1921.

Year.	N.S.W.	Q'land.	W. Aust.	Tasmania.	Nor. Ter.	Australia.
	No.	No.	No.	No.	No.	No.
1917	7,619	71	(a) 328	646	33	8,697
1918	7,585	98	(a) 382	631	10	8,706
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

(a) Lead ore.

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 1917 to 1921 are shown in the following tables :—

COPPER.—PRODUCTION, 1917 TO 1921.

State.	1917.	1918.	1919.	1920.	1921.
QUANTITY.					
	Tons.	Tons.	Tons.	Tons.	Tons.
New South { Ingot and Matte	6,576	6,510	1,460	1,290	499
{ Ore .. ..	..	..	..	..	..
Victoria { Ore .. ..	..	..	..	..	..
Queensland { Ingot and Matte	19,062	18,980	9,997	15,897	2,428
{ Ore .. ..	..	..	..	..	..
South Aus- { Ingot and Matte	7,213	7,169	2,517	4,339	1,532
tralia { Ore .. ..	..	..	..	..	..
Western { Ingot and Matte	535	478	4	137	206
Australia { Ore	966	1,643	455	1,511	1,040
Tasmania { Ingot and Matte	5,845	5,559	5,071	4,792	6,181
{ Ore	771	444	..	..	..
Northern { Ingot and Matte	..	..	..	..	..
Territory { Ore	(a) 48	(a) 619	(a) 159	(a) 67	..
VALUE.					
	£	£	£	£	£
New South Wales	814,154	696,580	139,296	127,978	41,267
Victoria .. ..	..	..	..	..	..
Queensland	2,208,232	2,087,751	952,501	1,551,995	168,556
South Australia	902,495	828,556	228,930	423,601	106,370
Western Australia	85,738	66,146	10,105	25,165	24,601
Tasmania	847,754	776,106	558,694	528,237	463,163
Northern Territory	(a) 5,517	(a) 9,648	(a) 2,349	(a) 780	..
Australia	4,863,890	4,464,787	1,891,875	2,657,756	803,957

(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.

2. Sources of Production.—(i) *New South Wales.* The production in this State in 1921 amounted to 499 tons valued at £41,267, as compared with 1,290 tons valued at £127,978 in the preceding year. The prevailing depression in this branch of the mining industry in 1921 was accentuated by the low prices ruling for copper and high costs of production and transport. The Cobar field produced only 55 tons, as against nearly 5,000 tons in 1917. Small yields were reported also from the Grenfell, Drake, Mount McDonald, Orange, Rockley, and the Yass divisions.

(ii) *Queensland.* The yield in this State amounted in 1921 to 2,428 tons valued at £168,556, and shows a serious decline as compared with the preceding year when nearly 16,000 tons valued at £1,552,000 were raised. The small return in 1921 was, of course, due to the low prices realized for copper. Yields from the chief producing areas were as follows—Mount Morgan, 1,289 tons, valued at £89,494; Etheridge, 814 tons, £56,515; Herberton, 98 tons, £6,805; Cloncurry, 89 tons, £6,178; and Chillagoe, 48 tons, £3,332. These yields naturally compare very unfavourably with those of the previous year. 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 only 89 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 1921 the output amounted to 1,532 tons, valued at £106,370, the bulk of the production being from the Wallaroo and Moonta Company which in normal times employs about 1,500 hands. Owing to low prices the value of the yield in 1921 was only about one-fourth that of the previous year.

(iv) *Western Australia.* The value of copper and ore exported from this State in 1921 was £24,601. According to the returns, the production in the West Pilbara field was 1,055 tons, valued at £18,955, while the Phillips River field showed a production of 95 tons, valued at £1,207. 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 1921 was 6,181 tons, valued at £463,163, the bulk of the production being due to the Mount Lyell Mining and Railway Co. Ltd. This Company treated 140,894 tons of ore—of which 37 tons were purchased from other mines—and produced 6,220 tons of blister copper, containing copper, 6,170 tons; silver, 183,020 ozs.; and gold 4,646 ozs.; the whole being valued at £512,862. The employees in 1921 numbered 1,359, of whom 689 were miners, 544 were engaged in the reduction works, and 128 in the railway department. Current for power and lighting is obtained from the Lake Margaret hydro-electric plant. To the end of 1921 this Company had paid upwards of £3,830,000 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. A small quantity of ore was raised in 1920, but none was recorded in 1921.

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, 1917 TO 1921.

Year.				London Price per Ton Standard Copper.	New York Price in Cents per lb. Electrolytic Copper.
				£	Cents.
1917	..	..	..	124.89	27.18
1918	..	..	..	115.53	24.63
1919	..	..	..	90.80	18.69
1920	..	..	..	97.48	17.46
1921	..	..	..	69.36	12.50

As evidence of the tremendous monthly variation during the period covered by the table, it may be noted that in February, 1917, the average London price of standard copper was £137 17s. 11d. per ton, while in November, 1921, it was quoted at £66 12s. 3d.

4. **World's Production of Copper.**—The world's production of copper during the five years 1917 to 1921, is estimated to have been as follows :—

COPPER.—WORLD'S PRODUCTION, 1917 TO 1921.

Year	..	..	..	1917.	1918.	1919.	1920.	1921.
World's production—tons	..	..	..	1,404,500	1,372,800	977,300	930,200	524,900

The yields from the chief copper-producing countries in 1921 were as follows :—

COPPER.—PRODUCTION, CHIEF COUNTRIES, 1921.

Country.			Production.	Country.			Production.
			Tons.				Tons.
United States	..	..	225,700	Canada	..	..	20,200
Chile	..	..	54,800	Australia	..	..	18,600
Japan	..	..	52,500	Germany	..	..	16,200
Africa	..	..	38,600	Mexico	..	..	12,100
Peru	..	..	33,300	Bolivia	..	..	9,500
Spain and Portugal	..	..	31,900	Cuba	..	..	7,700

The Australian production in 1921 amounted to about 3.5 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, 1917 TO 1921.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.	Australia.
	No.	No.	No.	No.	No.	No.	No.	No.
1917	2,074	..	3,154	2,000	154	1,671	92	9,145
1918	1,529	..	3,209	2,000	158	1,597	60	8,553
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

§ 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, 1917 to 1921 :—

TIN.—PRODUCTION, 1917 TO 1921.

State.	1917.	1918.	1919.	1920.	1921.
QUANTITY.					
New South Wales .. { Ingots	Tons. 1,109	Tons. 1,182	Tons. 1,146	Tons. ..	Tons. ..
{ Ore	963	738	1,546	2,486	1,595
Victoria { Ingots	..	..	..	..	..
{ Ore	139	135	113	84	80
Queensland { Ingots	(b)	(b)	(b)	(b)	(b)
{ Ore(a)	1,177	1,311	994	1,486	1,050
Western Australia .. { Ingots	..	..	..	..	..
{ Ore	383	415	318	243	67
Tasmania { Ingots	2,637	2,256	1,580	1,310	790
{ Ore	(c)	(c)	(c)	(c)	(c)
Northern Territory .. Ore	(d)270	(d)246	(d)162	(d)180	(d) 83
VALUE.					
New South Wales	£ 373,696	£ 548,876	£ 416,623	£ 413,794	£ 163,451
Victoria	19,709	24,481	17,561	12,815	11,961
Queensland	160,600	251,755	143,167	252,054	98,471
Western Australia	45,288	76,952	47,269	49,449	6,485
Tasmania	427,917	488,798	395,794	369,362	130,257
Northern Territory	(d)27,120	(d)41,432	(d)30,021	(d)27,610	(d)7,793
Total	1,054,330	1,432,294	1,050,435	1,125,084	418,418

(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 serious decline in the production of tin in 1921, 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. In New South Wales there was a serious decline in the returns from dredging in the New England district, and a company at Emmaville dismantled its plant, which was the largest of its kind in Australia. The Vegetable Creek Tin Mining Co., for many years the largest producer of tin in the State, also closed down owing to failure to locate the continuation of the lead. In Queensland all the tin treatment plants were idle for varying periods during the year.

2. **Sources of Production.**—(i) *New South Wales.* A large proportion of the output in New South Wales was obtained by dredging, the quantity so won in 1921 being 768 tons, valued at £76,550. Forty-seven pump, and 3 bucket dredges, of a combined value of £228,652, were in operation during the year. In the Tingha division of the Peel and Uralla district the yield amounted to 570 tons, valued at £57,161. The Emmaville division in the New England district showed a yield of 539 tons, valued at £52,532. 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. In the Wilson's Downfall division, 58 tons, valued at £6,309 were raised. The Glen Innes division, also in the New England district, returned a yield of 42 tons, valued at £3,917, and the Tarring-ton division 184 tons, valued at £21,242. The Ardlethan field, in the Lachlan division, produced ore and concentrates to the value of £12,242.

(ii) *Victoria*. The bulk of the production in 1921 was obtained by dredging and sluicing, the Cock's Pioneer Gold and Tin Co. in the Beechworth district contributing 73 tons, valued at £11,290.

(iii) *Queensland*. The chief producing districts in Queensland during 1921 were Herberton, 477 tons, valued at £43,006; Kangaroo Hills, 275 tons, £26,980; Stanthorpe, 125 tons, £12,249; Cooktown, 111 tons, £10,981; Chillagoe, 57 tons, £4,971. As pointed out previously, the low prices of the metal in 1921 had a depressing effect on the industry, the production for the year being valued at £98,000 as compared with £252,000 in 1920.

(iv) *Western Australia*. The export of tin ore for the State during 1921 amounted to 67 tons, valued at £6,485, as compared with 243 tons, valued at £49,449 in 1920. The production of black tin from the Greenbushes field amounted to 53 tons, valued at £5,778, and from the Pilbara field 14 tons, valued at £1,460. 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 goldfield.

(v) *Tasmania*. During 1921 the quantity of metallic tin won amounted to 790 tons, valued at £130,257, as compared with 1,310 tons, valued at £369,362, during the preceding year. The decrease is accounted for by depletion of supplies, low market values of tin, high production costs, and shortage of water, particularly in the North-Eastern division. The yield from this division, which in 1920 amounted to 604 tons, fell in 1921 to 392 tons. Of the total, 231 tons were contributed by the mines in the Pioneer and Gladstone districts, while 157 tons came from the Ringarooma, Derby, and Branxholm area. The yield in the Eastern division amounted to 142 tons, the St. Helen's Mines furnishing 82 tons. From the North-Western division the output was 205 tons, the bulk of it being raised by the Mt. Bischoff, with 193 tons. The production in the Western division was returned at 51 tons.

(vi) *Northern Territory*. The yield of tin ore in 1921 amounted to 83 tons, valued at £7,793, as against 180 tons, valued at £27,610 in 1920. The collapse was due to the low market price of tin, coupled with the high cost of stores, and increased treatment and transport charges. Stanniferous deposits are found at various places, including Maranboy, Hayes Creek, Mt. Wells, Crest of the Wave, Mary River, Horseshoe Creek, West Arm, Umbrawarra and Golden Gully, and Hidden Valley. Two batteries for the treatment of tin ore have been erected by the Government, one at Maranboy, 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, 1917 TO 1921.

1917.	1918.	1919.	1920.	1921.
Tons. 125,223.	Tons. 122,213	Tons. 116,485	Tons. 118,695	Tons. 107,948

The yields from the chief producing countries in 1921 were as follows :—

TIN.—PRODUCTION, CHIEF COUNTRIES, 1921.

Country.	Production.	Country.	Production.
	Tons.		Tons.
Malaya	36,300	Australia	3,000
Bolivia	19,400	India	1,900
Banka	14,900	South Africa	800
Billiton	12,000	Cornwall	700
Siam	6,200	Other Countries	1,600
China	6,100		
Nigeria	5,000	Total	107,900

Based on the results for the last three years, Australia's share of the world's tin production would appear to be about 3½ per cent.

4. Prices.—The average price of the metal in the London market for the years 1917 to 1921 was as follows:—

TIN.—PRICES, 1917 TO 1921.

Year.			Price per Ton.	Year.			Price per Ton.
			£ s. d.				£ s. d.
1917	..	..	237 13 1	1920	..	..	296 1 7
1918	..	..	329 11 2	1921	..	..	165 5 4
1919	..	..	257 9 8				

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.

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, 1917 TO 1921.

Year.			N.S.W.	Victoria.	Q'land.	W. Aust.	Tas.	Nor. Ter.	Australia.
			No.	No.	No.	No.	No.	No.	No.
1917	..	..	1,779	42	878	211	1,311	151	4,372
1918	..	..	2,352	52	1,110	292	1,260	190	5,256
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

§ 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 1921.

Year.			Quantity of Zinc Concentrates, etc., Exported.	Value.	Year.			Quantity of Zinc Concentrates, etc., Exported.	Value.
			Tons.	£				Tons.	£
1889			97	988	1918			87,019	295,413
1891			219	2,622	1919			72,294	247,395
1899			49,879	49,207	1920			71,043	249,456
1917			113,531	441,486	1921			79,694	283,455

(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 1918 to 1922, 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 railway connexion with the mine. 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.

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 in 1921.

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 1921 produced 1,118 tons of slab zinc, valued at £30,242. About 850 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., and for 1921, £25 16s. 11d. 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) *Lithgow Iron Works.* Reference to the extent of the deposits of iron-ore in the State, and 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 1921 the following materials were received at the blast furnace at the Eskbank Iron Works, Lithgow: Iron ore, 168,385 tons; limestone, 68,881 tons; slag, 3,455 tons, and coke, 130,561 tons. The iron-ore was raised from quarries at Tallawang, Cadia, Coombing Park, and Breadalbane, and the pig iron produced therefrom amounted to 90,053 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, 1917 TO 1921.

Particulars.			1917.	1918.	1919.	1920.	1921.
Quantity	..	Tons	45,025	68,072	80,941	86,096	90,053
Value	..	£	247,637	350,000	445,175	645,720	639,376

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.

(b) *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 36 miles, by the Company's tramway. The ore quarried for the year ending December, 1921, amounted to 463,578 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 1921 amounted to 262,312 tons, and of steel ingots to 255,437 tons. Further details in regard to the activities of these works in 1921 were given on page 347 of Official Year Book No. 15. During the succeeding twelve months, owing to various industrial and economic difficulties, production was limited, and any figures in relation thereto would not convey even an approximate idea of the capacity of the works. It may be stated, however, that 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. 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.

(c) *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 1921 the iron oxide raised amounted to 3,109 tons, valued at £2,917. The smelting companies utilize a certain amount of ironstone for fluxing purposes, the quantity so used in 1921 amounting to 7,473 tons, valued at £9,132.

(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. 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. The estimated quantity of iron ore in sight at the Iron Knob and Iron Monarch has been set down at 21,000,000 tons. 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.

(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; and Koolyanobbing, near Southern Cross, where there is a very large deposit of high-grade micaceous hematite. The production of pyritic ore reported in 1921 amounted to 6,117 tons, valued at £7,871.

(vi) *Tasmania*. The amount of ore available in the principal iron-ore deposits in Tasmania has been estimated as follows —

	Tons.
Blythe River Lode	17,000,000
Dial Range and Penguin	700,000
Beaconsfield and Anderson's Creek	1,300,000
Long Plain	20,000,000
Zeehan District	2,900,000
Nelson River	Unknown
Total	41,900,000

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 owing to 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 1921 being 606 tons, valued at £2,579.

(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.

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 Iron Trade Review* the world's production of pig iron in the year 1913 was estimated at roughly 77 million tons; in 1920 at 61 million, and in 1921 at 36 million tons. During each of the three years specified the respective shares of the principal producing countries were as follows:—United States, 31, 36, and 17 millions; Germany, 19, 6½, and 7½ millions; and Great Britain, 10, 8, and 3 millions. The world's steel production for the same three years was estimated at 75, 68, and 41 million tons. To these totals the United States contributed 31, 42, and 20 millions; Germany, 19, 8, and 9 millions; and Great Britain, 8, 9, and 4 million tons.

§ 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. During the year prospecting was carried on in the Glen Innes and Drake divisions. The total quantity of antimony (metal and ore) raised in New South Wales up to the end of 1921 was 19,032 tons, valued at £344,588. The production of antimony concentrates in Victoria during 1921 amounted to 347 tons, valued at £5,890. 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 in 1920 and 1921. 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 1921.

2. **Arsenic.**—In New South Wales the production of arsenic in 1921 amounted to 397 tons valued at £17,865, of which 196 tons were raised at the Ottery Mine in the Emma-ville division, 138 tons at Urunga in the Kempsey division, while smaller quantities were produced in the Port Macquarie 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 Jibbenbar, in the Stanthorpe district. Production in 1921 amounted to 220 tons, valued at £12,325. There has been 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 Woodside, at Westward Ho, near Mannahill, and on Kangaroo Island. During 1920 Western Australia exported 1,765 tons of arsenical ore, valued at £4,260, but in 1921 the export fell to 7 tons, valued at £16.

3. **Bismuth.**—This metal is found principally in association with molybdenite in New South Wales, but owing to lack of market for these minerals the production of bismuth in 1921 was only 8 tons, valued at £912, of which $6\frac{1}{2}$ tons valued at £660 were obtained in the Torrington division. The total production to the end of 1921 was 768 tons, valued at £223,840. 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 1921. 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.

4. **Chromium.**—The output of chromite in New South Wales during 1921 was estimated at 62 tons, valued at £124, of which 52 tons were raised at Upper Bingara, and 10 tons in the Gulgong mining area. 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 in 1921.

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 in the Cloncurry area, and the production in 1921 amounted to 85 tons, valued at £21,332. Although the metal is a valuable one, greater development was 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 1921 for 20,353 tons, valued at £462,862, and the production to the end of 1921 was taken as 318,000 tons, valued at £6,248,000. 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 of 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 1921 amounting to 1,057 tons, valued at £24,077. Of this total the Chillagoe area produced 881 tons, valued at £20,070, and the Brisbane area 85 tons, valued at £1,929. During 1921 pig lead exports from Western Australia amounted to 2,156 tons, valued at £48,863. Tasmanian lead production in 1921 was returned as 1,435 tons, valued at £32,241, of which the Zeehan mines contributed 698 tons, the North Mt. Farrell mines, 377 tons, Magnet 195 tons, and Round Hill mines, 165 tons.

7. **Manganese.**—During 1921 the output of manganese ore in New South Wales amounted to 3,515 tons, valued at £10,545, the bulk of the production being raised in the Grenfell division. A small quantity was also raised in the Gulgong division, and a promising discovery was made during the year in the Deepwater division. In Victoria the production amounted to 10 tons, valued at £100, raised in the Heathcote division. 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 1921 amounted to 833 tons, valued at £4,710. 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 1921 was valued at £9,774. 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 1921 consisted of 16 tons, valued at £145.

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, but developmental and prospecting work was carried out in the Dalmorton, Glen Innes, and Tenterfield divisions. The total production of molybdenite since its discovery is stated at 840 tons, valued at £214,000. In Victoria 5 tons of molybdenite, valued at £70, were raised in 1921 at Everton. The production in Queensland for 1921 was 9 tons, valued at £2,187, raised 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, but there was no production recorded in 1921. 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.**—Reference to the occurrence of radio-active minerals in Australia and also to the manufacture of radium bromide in Sydney in 1914 has been made in previous issues of the Official Year Book, (see No. 15, p. 353), but in view of the absence of later developments the information is not repeated in the present issue.

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 1921. 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 production in 1921. In Queensland, tungsten ores are found in several districts, but owing to low prices production in 1921 was practically negligible. (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 1921 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. Owing to the low price there was no production in 1921. Wolfram is mined at various points in Tasmania, the production for 1921 being 10 tons, valued at £676, obtained chiefly at the Avoca mines. Scheelite has been discovered on King Island in Bass Strait, but there was no production in 1921.

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, 1917 to 1921, are given in the table hereunder:—

COAL.—PRODUCTION, 1917 TO 1921.

Year.	N.S.W.	(a)Victoria.	Q'land.	S. Aust.	W. Aust.	Tasmania.	Australia.
QUANTITY.							
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1917 ..	8,292,867	466,220	1,048,473	..	326,550	63,412	10,197,522
1918 ..	9,063,176	439,575	983,193	..	337,039	60,163	10,883,146
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
VALUE.							
	£	£	£	£	£	£	£
1917 ..	4,422,740	335,259	597,360	..	191,822	38,673	5,585,854
1918 ..	4,941,807	349,696	572,305	..	204,319	37,676	6,105,803
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

(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, 1917 TO 1921.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Tons.	£		Tons.	£
1917 ..	39,144	10,571	1920 ..	162,682	64,180
1918 ..	66,200	17,944	1921 ..	79,224	31,074
1919 ..	111,628	34,542			

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.
I. Tertiary—Eocene to Pliocene ..	Approx. 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 large 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. 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, has been idle for some years, but a new company has been formed to re-open it. 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 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 1917 to 1921:—

COAL.—PRODUCTION IN DISTRICTS, NEW SOUTH WALES, 1917 TO 1921.

District.	1917.	1918.	1919.	1920.	1921.
	Tons.	Tons.	Tons.	Tons.	Tons.
Northern	5,380,957	5,966,926	5,629,253	7,320,510	7,493,002
Southern	1,841,869	1,984,578	1,826,574	1,902,889	2,062,958
Western	1,070,041	1,111,672	1,175,727	1,492,600	1,237,427
Total	8,292,867	9,063,176	8,631,554	10,715,999	10,793,387

The output in 1921 was the highest yet recorded, the nearest approach to it being that for 1913, when 10,414,000 tons were raised. During the year deposits of lignitic coal at Coorabin, near Oaklands, were prospected with a view to exploitation on a commercial basis.

(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.

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

BLACK COAL.—PRODUCTION, VICTORIA, 1917 TO 1921.

Year.	State Coal Mine.	Outtrim Coal Syndicate.	Jumbunna Coal Company.	Coal Creek.	Austral Coal.	Powlett North Woolamai.	Sunbeam Collieries.	Total Pro- duction.	Value.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	£
1917 ..	405,498	..	22,236	1,958	13,888	20,149	2,491	466,220	335,259
1918 ..	389,794	..	15,533	2,378	15,419	11,975	3,476	439,575	349,696
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

(b) *Brown Coal.* 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. A briquetting plant estimated to cost £400,000 is in course of construction. The capacity of this plant will be about 350 tons per day. It is proposed to establish a township at Yallourn with provision for an ultimate population of 3,000. On the 30th June, 1922, there were 1,364 employees engaged on the various works of the Commission as follows—At Yallourn, 943; Transmission Lines, 126, Metropolitan Works, 295. Based on the results from boring, it has been estimated, that 10,978 millions of tons are available in the various beds.

The brown coal produced in Victoria is raised chiefly at the State Mine at Morwell, where the output in 1920 amounted to 162,682 tons, and in 1921 to 74,453 tons. During the latter year 4,766 tons were also raised by the Victorian Central Coal and Iron Co. at Lal Lal. Particulars regarding production for the last five years are given on page 815.

(iii) *Queensland.* In Queensland the coal-bearing strata are of vast extent and wide distribution, being noted under the greater portion of the south-eastern districts, within 200 miles of the sea, as far north as Cooktown, and under portions of the far western interior. The Ipswich beds are estimated to occupy about 12,000 square miles of country, while the Burrum fields occupy a considerably larger area. At Callide, fifty miles west of Gladstone, a seam of coal free from bands has been struck in a shaft only 60 feet deep, and borings have proved the deposit to be of considerable magnitude. The beds in the Cook district are estimated to comprise rather more than 1,000 square miles, but coal measures extend to the south-west far beyond Laura and to the north of the railway. Extensive beds occur in the basin of the Fitzroy River, in the Broadsound district, and at the Bowen River. Amongst other places where the mineral is found may be enumerated Clermont, the Palmer River, Tambo, Winton, Mount Mulligan, and

the Flinders River. Boring operations have proved the existence of seams of workable coal for some distance on both sides of the Dawson River. A bituminous coal is yielded by the Ipswich seams, those of the Darling Downs yield a cannel, while anthracite of good quality is furnished by the Dawson River beds. The seam of coal at Blair Athol has been proved in places to have a thickness of at least 93 feet, and it is stated to be probably the thickest seam of black coal in the world.

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

COAL PRODUCTION.—QUEENSLAND, 1919 TO 1921.

Districts.	1919.	1920.	1921.
	Tons.	Tons.	Tons.
Ipswich	620,608	763,590	666,236
Darling Downs	97,454	102,074	94,044
Wide Bay and Maryborough	63,665	61,170	69,633
Rockhampton (central)	8,350	10,522	30,719
Clermont	121,250	145,001	75,549
Bowen (State Coal Mine)	306	3,914	2,138
Mount Mulligan (Chillagoe)	19,998	23,642	16,444
Total	931,631	1,109,913	954,763

The industry was subject to periods of slackness in 1921, particularly in the latter part of the year, and this is reflected in the smaller output from the principal districts, Ipswich and Clermont. During the year 1921-22 overseas exports amounted to 5,235 tons, valued at £6,011, of which 4,146 tons were forwarded to New Zealand and 1,089 tons to Hong Kong.

Operations were commenced at the State Coal Mine on the Bowen field in March, 1919. The coal is of good 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. Coal of excellent quality has been raised from the prospecting shafts of the State Coal Mine at the Styx River, in the Rockhampton division. There is also a State Coal Mine at Baralaba, in the Mount Morgan area.

(iv) *South Australia.* The coal from Leigh's Creek in South Australia is subject to similar disabilities to those of the Victorian brown coal, and until some means are devised of overcoming them, production will probably languish. The deposit is situated about 370 miles by rail from Adelaide, and 160 from Port Augusta, the total extent of coal-bearing country being set down as 42 square miles. The main seam has a thickness of over 45 feet. As the result of experiments made it would appear probable that profitable use might be made of the coal in a pulverized form. Investigation is at present being made on the site of a deposit of brown coal in Hope Valley, and borings have been made to test deposits at Moorlands and Clinton.

(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 coal produced is bright and clean, but very fragile when free from moisture. Boring operations undertaken by the Government have proved the existence of coal measures at Wilga and Irwin River. The production from the five collieries situated at Collie amounted in 1921 to 468,817 tons, as compared with 462,021 tons in 1920, and 401,713 tons in 1919.

(vi) *Tasmania.* In Tasmania, coal occurs in the following geological periods :—
 (1) Permo-Carboniferous: Lower Coal Measures. (2) Mesozoic: Upper Coal Measures.
 (3) Tertiary: Brown Coal and Lignite deposits. Permo-Carboniferous coal is found at Avoca, Mt. Nicholas and Fingal, Thomson's Marshes, Langloh, Seymour, York Plains,

Mike Howe's Marsh, Longford, Colebrook, Schouten Island, Spring Bay and Prosser's Plains, Compton and Old Beach, Lawrenny, Longhole, Sandfly, Ida Bay, Hastings and Southport, Recherché and South Coast, Tasman's Peninsula. Deposits of lignite and brown coal are plentiful in beds of Tertiary age, but they have not been exploited to any extent. An estimate gives the approximate quantity of coal available as sixty-five million tons, of which eleven millions are in the Lower Coal Measures and fifty-four millions in the Upper Measures, exclusive of an unknown quantity in strata fringing the Central Tiers. Of the total output in 1921, amounting to 66,476 tons, the Cornwall and Mt. Nicholas Collieries in the North-eastern Division raised 36,562 and 24,926 tons respectively. The quantity and value of the coal raised in each division during the year were as follows:—North Western, 895 tons, £1,360; North Eastern, 63,750 tons, £60,091; Midland, 662 tons, £826; and South Eastern, 1,169 tons, £1,169.

3. **Production in Various Countries.**—The total known coal production of the world in 1921 amounted to about 1,280 million tons, towards which Australia contributed nearly 13 million tons, or over 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 1917 to 1921 where the returns are available. The figures for the British Empire and the United States are extracted 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, 1917 TO 1921.

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.
1917	248,500	18,200	12,500	10,200	2,100	9,300
1918	227,700	20,700	13,400	10,900	2,000	8,800
1919	229,800	22,600	12,200	10,500	1,800	9,200
1920	229,500	18,000	14,800	13,000	1,800	10,200
1921	163,000	..	..	13,000	1,800	10,200

COAL PRODUCTION.—FOREIGN COUNTRIES, 1917 TO 1921.

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.
1917 ..	259,100	14,700	28,500	..	..	3,000	25,900	581,800
1918 ..	257,100	13,700	25,800	..	..	4,800	27,600	605,600
1919 ..	207,100	18,200	21,500	27,000	..	5,200	30,800	486,000
1920 ..	239,200	22,000	34,100	30,300	6,300	5,200	23,800	578,600
1921 ..	255,000	21,400	37,900	32,200	7,500	4,000	23,000	449,900

The United States returns include a large proportion of anthracite, the quantity averaging for the last five years about 83 million tons.

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 1921 was 1,592,523 tons, valued at £1,740,584, of which amount 1,544,000 tons were exported from New South Wales, and 48,000 tons from Queensland.

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, 1917 TO 1921.

Year	1917.	1918.	1919.	1920.	1921.
Quantity, 1,000 tons	3,264	3,422	3,504	4,987	5,525
Value, £1,000	2,384	2,525	2,919	4,591	5,794

Arranged in order of importance the principal oversea countries to which coal was exported from New South Wales during the year 1921–22 are as shown hereunder. The quantity and value refer strictly to exports, and exclude bunker coal :—

COAL.—DESTINATION OF OVERSEA EXPORTS, NEW SOUTH WALES, 1921–22.

Country.	Quantity.	Value.	Country.	Quantity.	Value.
	Tons.	£		Tons.	£
New Zealand	423,117	440,868	Fiji	37,598	38,780
Netherlands East Indies	205,297	219,919	New Caledonia	22,335	25,166
United States	82,040	89,507	Hawaiian Islands	21,008	22,405
Straits Settlements	63,505	70,803	Peru	15,378	17,045
India	59,712	65,643	Chile	9,367	10,011
Philippine Islands	53,591	59,163	Society Islands	8,709	9,393

The quantity of bunker coal taken from New South Wales by oversea vessels was about 1,174,000 tons.

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, 1917 TO 1921.

Year.	Exports to Australian Ports.	Exports to Foreign Ports.	Local Consumption.	Total.
	Tons.	Tons.	Tons.	Tons.
1917	2,225,228	1,038,569	5,029,070	8,292,867
1918	2,697,033	724,643	5,641,500	9,063,176
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

Of the total coal exports from New South Wales, amounting in 1921 to 5,525,000 tons, about 4,589,000 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, 1917 TO 1921.

Year.	Quantity of Coal Consumed.		
	Home Produce.	Produce of Other Countries.	Total.
	Tons.	Tons.	Tons.
1917	8,985,599	65,512	9,051,111
1918	9,866,323	23,777	9,890,100
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

The bunker coal taken away in 1921 was estimated at 1,508,000 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, 1917 TO 1921.

Year.	Northern District.		Southern District.		Western District.	
	Per Ton.		Per ton.		Per ton.	
	s.	d.	s.	d.	s.	d.
1917	11	5.14	9	11.89	7	11.92
1918	11	8.03	9	10.32	8	8.04
1919	13	5.81	11	9.64	9	4.19
1920	15	2.95	13	4.45	11	8.01
1921	17	6.75	16	6.00	12	10.46

(ii) *Victoria*. In Victoria the average price of coal in 1917 was 14s. 5d.; in 1918, 15s. 11d.; in 1919, 17s. 7d.; in 1920, 21s.; and in 1921, 23s. 5d. per ton. These averages are exclusive of brown coal, the production of which in 1921 was valued at 7s. 10d. per ton.

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

COAL.—PRICES, QUEENSLAND, 1917 TO 1921.

District.	Value at Pit's Mouth.				
	1917.	1918.	1919.	1920.	1921.
	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
Ipswich	10 8	11 0	12 7	14 7	16 6
Darling Downs	12 9	13 5	14 10	16 7	18 10
Wide Bay and Maryborough	15 10	16 9	19 2	23 3	27 3
Rockhampton	11 10	12 4	13 4	16 1	15 6
Clermont	11 5	10 5	11 2	13 0	14 4
Bowen (State Coal Mine) ..	..	..	15 0	15 10	16 3
Mount Mulligan (Chillagoe)	15 6	16 6	17 8	19 0	19 10
Average for State ..	11 5	11 8	13 2	15 2	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 1917, 11s. 9d.; in 1918, 12s. 1d.; in 1919, 13s. 5d.; in 1920, 15s. 2d.; and in 1921, 17s. 4d. per ton.

(v) *Tasmania*. The average price per ton of coal at the pit's mouth in Tasmania for the five years 1917 to 1921 was—In 1917, 12s. 2d.; in 1918, 12s. 6d.; in 1919, 14s. 2d.; in 1920, 16s. 11½d.; and in 1921, 19s. 1d. per ton.

7. Prices in the United Kingdom.—During the five years 1916 to 1920 the average value of coal at the pit's mouth in the United Kingdom rose rapidly, the price in 1916 being 15s. 7d.; in 1917, 16s. 9d.; in 1918, 20s. 11d.; in 1919, 27s. 4d.; and in 1920, 34s. 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 1921 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, 1917-1921, was 1.72. 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, 1921.

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 ..	21,265	19	113	0.89	5.31	568,100	95,500
Victoria ..	1,994	5	11	2.51	5.52	118,800	54,000
Queensland ..	2,637	(a) 77	24	29.20	9.10	12,400	39,800
Western Australia ..	870	1	52	1.15	5.98	468,800	9,000
Tasmania ..	206	..	10	..	48.54	..	6,600
Total ..	26,972	102	210	3.78	7.79	126,300	61,300

(a) 75 deaths were due to an explosion of coal-dust at Mount Mulligan.

The figures for New South Wales include a small number of shale miners. 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 1917-21 :—

COAL MINING.—FATALITIES, 1917 TO 1921.

State.	Average No. of Coal Miners.	Average No. of Fatal Accidents.	Rate per 1,000 Employed.
New South Wales ..	18,734	18	0.96
Victoria ..	1,868	3	1.61
Queensland ..	2,353	19	8.07
Western Australia ..	723	1	1.38
Tasmania ..	201	..	..
Total ..	23,879	41	1.72

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, 1917 TO 1921.

Year	1917.	1918.	1919.	1920.	1921.
Quantity .. tons	455,587	608,492	424,773	567,569	592,097
Value, total .. £	541,093	647,798	550,127	844,191	1,029,694
Value, per ton ..	23s. 9d.	21s. 4d.	25s. 11d.	29s. 9d.	34s. 9d.

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.

A small quantity of coke is made in Queensland, the quantity returned in 1921 being 7,557 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, 1917 TO 1921.

Year	1917.	1918.	1919.	1920.	1921.
Quantity .. tons	13,399	14,437	4,562	19,653	7,557

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 1921 to 32,489 tons, valued at £77,380, as compared with 21,004 tons valued at £46,082 in 1920. The whole of the yield in 1921 was obtained in the Western District, chiefly from the Wolgan Valley deposits. Recently an attempt was made at Newnes to retort the shale in situ, supplying sufficient air from the workings to maintain combustion, but apparently the process was not satisfactory. Up to date there has been no production of petroleum in the State, but prospecting operations were continued during 1921 in several localities, and boring was undertaken at Auburn Vale in the Inverell division, at Yerrinbool, near Mittagong, at Parkville in the Scone division, and near Tamworth.

(ii) *Victoria.* Up to the present no extensive deposit of oil shale has been located in Victoria.

(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. Attempts made at the recovery of the petroliferous gas were also unsuccessful. Oil-bearing shales are common in many parts of the State, but their extent and nature have not yet been accurately determined. It has been stated that borings have not yet penetrated to a sufficient depth to properly test the strata for oil and gas.

(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. Expert opinion now, however, inclines to the idea that the material is sea-borne, but the source of origin is unknown. 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. Early in 1922 the Government Geologist reported that a bore on Kangaroo Island, which reached a depth of 307 feet, had penetrated rocks so dense in texture, broken, and tilted, that they could not be regarded as possible reservoirs of petroleum.

(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. Private prospectors reported the occurrence of petroleum in bores put down on the Upper Fitzgerald River on the south coast, but official investigation proved the supposed indications to be misleading.

(vi) *Tasmania.* Tasmanite 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 1921 the output was 868 tons valued at £1,506. The Mines Department proposed during 1922 to make a detailed investigation of the oil shale resources of the State, and to determine the method of retorting best suited to the type of shale.

(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 no developments have yet been recorded.

(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.

2. *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.

3. *Shale Oil Bounties.*—The Shale Oil Bounty Act 1917–22 provides for bounty amounting to £270,000 in accordance with the following scale:—On each gallon up to 3½ millions, 3½d. per gallon; over 3½ millions up to 5 millions, 2d.; over 5 millions to 8 millions, 1½d.; and over 8 millions, 1½d. The maximum amount payable in a year is £67,500.

On the 2nd January, 1920, the Commonwealth Government offered a reward of £10,000 for the discovery of petroleum oil in Australia, subject to the fulfilment of certain conditions. The reward was increased to £50,000 on the 9th September, 1920. During 1920 the New South Wales Government offered the sum of £10,000 as a bonus for the production of 100,000 gallons of petroleum within the State. Under the Native Industries Encouragement Act of 1872, the Government of South Australia offered a bonus of £5,000 on the production within the State of 100,000 gallons of crude petroleum containing not less than 90 per cent. of products obtainable by distillation.

§ 13. Other Non-Metallic Minerals.

1. *Alunite.*—The production of this mineral in New South Wales amounted during 1921 to 520 tons, valued at £2,080, raised at Bullahdelah. During recent years the output has fallen considerably, owing to increasing difficulty in locating a marketable product. The mineral is sent to England for treatment, and, to the end of 1921, the exports were 55,000 tons, valued at £196,000.

In South Australia an extensive deposit of the mineral was located in 1913 at Carriackalinga 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 small production of 15 tons in 1921.

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 945 tons, valued at £23,736, were raised during 1921 chiefly from deposits in the Barraba division, small yields being obtained also in the Gundagai and Orange divisions. 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 1921 amounted to 40 cwt., valued at £71. 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 export in 1921 amounted to 235 tons valued at £13,581, 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. The production in South Australia during 1921 was given as 1,269 tons, valued at £4,465. In this State there are extensive deposits of the mineral in the Willunga and other districts. 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. 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 1921.

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 1921 to 443 tons, valued at £544. About 340 tons of yellow ochre were raised at Eumungerie in the Dubbo division, and small quantities of red ochre were produced in the Glen Innes and Gulgong divisions. The output of silica was approximately 19,000 tons, raised chiefly at Ulladulla, and at Marrangaroo in the Lithgow division.

Attention is being devoted to the question of the recovery of the aluminium contents of the extensive deposits of bauxite near Wingello in the Moss Vale division, and deposits in the Inverell division are also being tested with a view to their development commercially. In Victoria 2,142 tons of kaolin, valued at £1,577, were produced in 1921 from deposits at Stawell, Egerton, Bendigo, and Pyalong. A small quantity of pigments was raised from leases in the Balnarring, Gordon, Heathcote, and Strangways areas. In Queensland, 1,691 tons of fireclay, valued at £589, were mined during 1921 in the Mount Morgan district. 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. Production of ochre in 1921 amounted to 197 tons, valued at £1,328. 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. Kaolin is obtained from deposits in the Darling

Range. 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, in Tasmania, 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.

5. **Felspar.**—During 1921, the production of this mineral in New South Wales was 25 tons, valued at £31, raised in the Lithgow division.

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 1921. In Victoria 196 tons, valued at £625, were raised in 1921 by a company operating at Walwa. A company operating in 1921 at a mine near Emuford in the Herberton district in Queensland produced 536 tons, valued at £1,609.

7. **Fuller's Earth.**—Small quantities of this material were produced in 1920 from deposits in the Boggabri area of the Narrabri division, New South Wales, but there was no production recorded in 1921.

8. **Graphite.**—Graphite is found in New South Wales near Undercliff Station, in the county of Buller, and 40 tons were raised during 1920. Owing to the low grade of the ore there is only a limited market for it, and no production was recorded in 1921. 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, at Northampton, in the Murthison 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 none was recorded in 1921.

9. **Gypsum.**—The output of gypsum in New South Wales during 1921 was 300 tons, valued at £210, and was obtained in the Hillston division. In Victoria during 1921 there was a production of 11,139 tons, valued at £6,914, of which 4,303 tons were raised at Boort, 2,502 tons at Lake Boga, 2,055 tons at Lascelles, 1,580 tons at Bolton, 565 tons at Cowangie, and 134 tons at Chillingollah. Numerous deposits of gypsum are found in Southern Yorke's Peninsula in South Australia. The production in 1921 amounted to 34,000 tons, valued at £29,000. 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, valued at £622, obtained at Koorda.

10. **Magnesite.**—Deposits of this mineral have been discovered at several localities in New South Wales. During 1921 the output was 12,268 tons, valued at £14,407, of which about 6,000 tons were raised at Attunga in the Tamworth division, 5,000 tons in the Fifield division, while small quantities were raised in the Bingara and Cobar divisions. The mineral is found at Heathcote in Victoria, where 128 tons, valued at £384, were produced in 1921. 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 1921 amounted to 172 tons, valued at £373. A large area of magnesite-bearing country has been located in Western Australia at Bulong, about 20 miles east of Kalgoorlie. The mineral is of a high degree of purity, but there has been no production of importance since 1915.

11. Phosphate Rock.—During 1921 about 200 tons of phosphate, valued at £50, were obtained in New South Wales at Molong and Borenore. In Victoria 1,541 tons, valued at £1,541, were raised at Mansfield. The production in Queensland amounted to 369 tons, valued at £1,570, raised by the Holbourne Island Phosphate Company in the Bowen district. South Australia possesses deposits scattered over a wide area between Willunga in the south and Carrieton in the north, and between Clinton on Yorke Peninsula and Bright to the north of Eurola. Production in 1921 amounted to 5,079 tons, valued at £6,203. 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 also 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. A bore put down near Kingscote, on Kangaroo Island, revealed brine from which salt can be profitably obtained by evaporation. About 56,000 tons of crude salt, valued at £127,000, were produced during 1921. 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. Tripolite, or 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 1921 was 206 tons, valued at £584, of which 117 tons were raised in the Cooma division, and 89 tons at Bell's Gully in the Barraba division. In Victoria there is a remarkably pure deposit at Lilliecur, 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. 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 circumstances 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 1921 in New South Wales was estimated at 1,563 carats, valued at £1,915, while the total production to the end of 1921 is given at 200,000 carats, valued at £142,000. The yield in 1921 was contributed chiefly by miners working in the vicinity of Copeton, in the Tingha division, and at Staggy Creek, in the Inverell 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 1921 was returned as 1,683 ozs., valued at £2,976, of which 1,583 ozs., valued at £2,926, were obtained on the Inverell field, and 100 ozs., valued at £50, in the Tingha division.

In Queensland, sapphires to the value of £46,524 were obtained in 1921 on the Anakie mineral field. The stones were classified as follows:—Parcel blues, £40,354; fancy stone, locally cut, £1,192; and mechanical stones, machine and corundum, £4,977. Under the agreement between the Government and Messrs. Rubin Bros. buying was resumed in February, and £20,000 worth of stones were purchased, the average price for first grade parcel blues being £7 11s. Buying was continued on a smaller scale till September, when the agreement with Rubin Bros. was terminated. Attempts at development of the gem deposits at Woodbine or Diamond Hills met with little success. The stone is of inferior quality to that obtained on the Anakie field, although a little was disposed of at satisfactory prices.

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 1921 was £13,020, compared with £23,600 in the preceding year. The great bulk of the yield came from the Lightning Ridge field, near Walgett, the production being returned as £12,500. Small yields were reported from White Cliffs, and from the Ballina division. 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 £1,511,000.

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 1921 was estimated at £500, and up to the end of that year at about £180,000. 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 1921 at the Stuart's Range opal fields in South Australia. The miners, on the advice of experts, made no attempt to dispose of their produce on an unwilling market. No value was, therefore, assigned by the Mines Department to the yields obtained.

According to a report 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. The Commissioner is also making inquiries into the possibilities of markets in Java and India.

4. Other Gems.—Various other gems and precious stones have from time to time been discovered in the different States, the list including agates, beryls, chiasolite, emeralds, garnets, rubies, topazes, tourmaline, turquoises, and zircons, but none of these figured in the returns of production for 1921.

§ 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 1921 the number so employed was as follows :—

NUMBER OF PERSONS ENGAGED IN MINING, 1921.

State.	Number of Persons Engaged in Mining for						Total.
	Gold.	Silver, Lead, and Zinc.	Copper.	Tin.	Coal and Shale.	Other.	
New South Wales	1,516	3,150	109	1,321	21,265	2,340	29,701
Victoria	3,050	..	..	31	1,994	136	5,211
Queensland	722	229	675	864	2,637	720	5,847
South Australia	100	..	1,000	..	..	920	2,020
Western Australia	6,019	41	36	59	870	59	7,084
Tasmania	67	352	1,361	699	206	485	3,170
Northern Territory	10	..	6	100	..	15	131
Australia	11,484	3,772	3,187	3,074	26,972	4,675	53,164

The following table shows the number of persons engaged in mining in Australia during each of the years 1891, 1901, and 1921, 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 1921.

State.	1891.		1901.		1921.	
	Miners Employed.	No. per 100,000 of Popu- lation.	Miners Employed.	No. per 100,000 of Popu- lation.	Miners Employed.	No. per 100,000 of Popu- lation.
New South Wales	30,604	2,700	36,615	2,685	29,701	1,408
Victoria	24,649	2,151	28,670	2,381	5,211	339
Queensland	11,627	2,934	13,352	2,664	5,847	765
South Australia	2,683	834	7,007	1,931	2,020	406
Western Australia	1,269	2,496	20,895	11,087	7,084	2,126
Tasmania	3,988	2,695	6,923	4,017	3,170	1,486
Northern Territory .. ..	..	..	..	..	131	3,351
Australia	74,820	2,341	113,462	2,992	53,164	974

2. Wages Paid in Mining.—Information regarding 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, 1921.**—The following table gives particulars of the number of men killed and injured in mining accidents during the year 1921 :—

MINING ACCIDENTS, 1921.

Mining for—	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T.	Australia.
KILLED.								
Coal and shale	19	5	77	..	1	..	..	102
Copper ..	..	..	1	1	..	3	..	5
Gold ..	2	5	..	..	15	..	..	22
Silver, lead, and zinc ..	1	..	..	..	..	..	..	1
Tin ..	1	..	..	..	1	..	..	2
Other minerals	..	..	..	..	..	..	..	..
Total ..	23	10	78	1	17	3	..	132

INJURED.								
Coal and shale	113	11	24	..	52	10	..	210
Copper ..	..	..	4	2	..	19	..	25
Gold ..	2	2	8	..	292	..	..	304
Silver, lead, and zinc ..	19	..	2	..	..	3	..	24
Tin ..	1	..	..	..	..	2	..	3
Other minerals	..	..	3	..	..	1	..	4
Total ..	135	13	41	2	344	35	..	570

The fatalities in Queensland collieries were considerably greater in 1921 than in any previous year, owing to the disastrous explosion of coal dust at Mount Mulligan, which resulted in the loss of 75 lives.

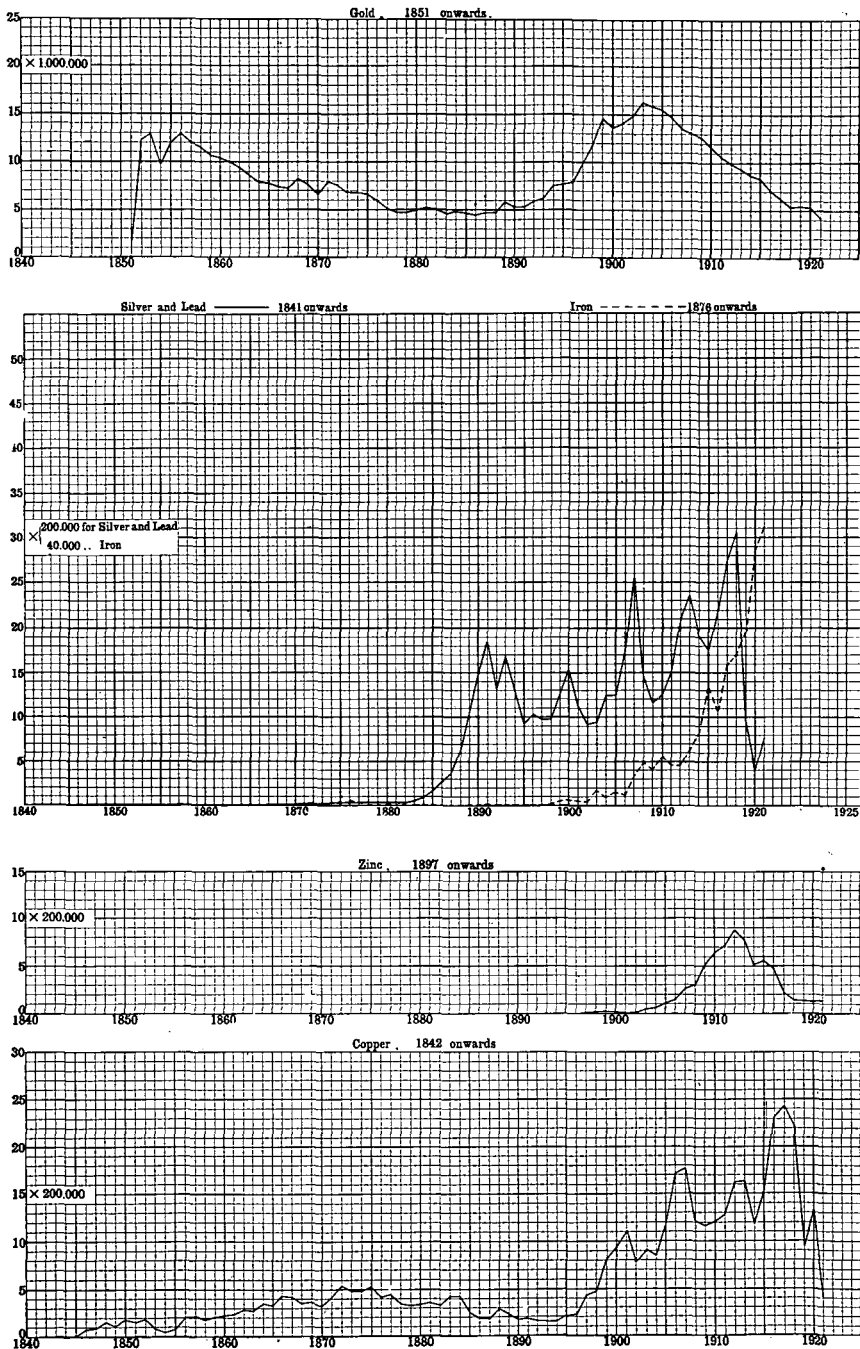
§ 16. State Aid to Mining.

1. **Introduction.**—The terms and conditions under which the States granted aid in 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 1921 the total sum expended in this manner amounted to £515,448, of which £10,411 was advanced in 1921. 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 the allotments therefrom amounted to £200.

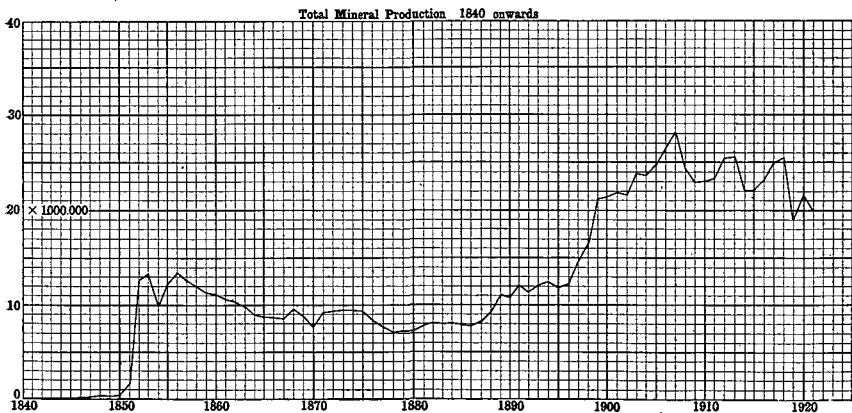
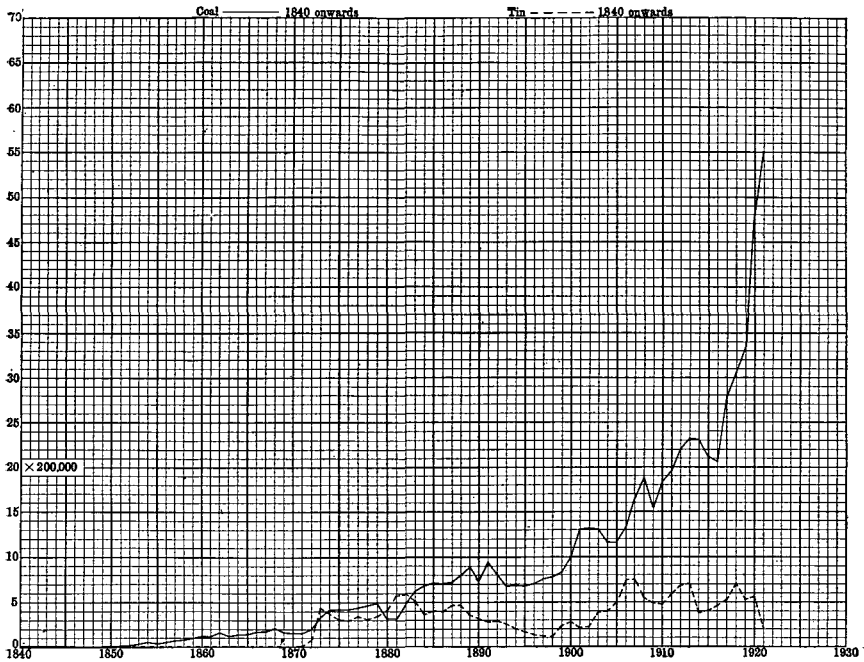
3. **Victoria.**—Since the passage of the Mining Development Act in 1897, the expenditure under its varying provisions has been £943,633, of which £272,849 was disbursed in connexion with advances to companies, £292,836 on boring, £192,535 on mining enterprise, £99,150 on advances to miners, and £86,263 on maintenance, removal, etc., of batteries. The expenditure for the financial year 1921-22 amounted to nearly £23,000, about half of which was spent on boring for gold and coal. During this year the Morning Star Gold Mine at Wood's Point made a further payment of £10,000, thus completing the repayment of the sum of £14,000 advanced on loan by the Department.

VALUES OF THE PRINCIPAL MINERALS PRODUCED—AUSTRALIA, 1840 TO 1921.



EXPLANATION.—The values shown are those of the total Australian production of certain of the most important minerals in successive years from 1840 to 1921.

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 1921—*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 1921.

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.

4. **Queensland.**—State assistance to the mining industry in 1921 amounted to £24,291, of which £5,521 consisted of loans in aid of deep sinking; £12,989 grants in aid of prospecting; £1,281 in aid of roads and bridges to gold and mineral fields; and £4,500 for the purchase of land at Styx River.

During the year the copper furnace at the Chillagoe State Smelters was in blast for 152 days, and smelted 28,506 tons for a production of 946 tons of blister copper. The State Arsenic Works at Jibbinbar produced 258 tons of high-grade arsenic. Tin, wolfram, and molybdenite are treated at the State Battery at Bamford, which, on account of low prices, only worked intermittently during the year. A new State battery was in course of erection at Kidston on the Etheridge gold-field. The State Assay Office at Cloncurry was fully employed, and a new and more efficient plant has been installed.

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 1921 the total amount of subsidy paid was £65,109, of which £12,125 has been repaid, and £2,250 written off, leaving a debit of £50,734. 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 1921 in accordance with the subjoined statement :—Advances in aid of mining work and equipment of mines with machinery, £24,625; aid to prospectors, £7,399; advances in aid of boring, £5,648; subsidies paid on stone crushed for the public, £270; making a total of £37,942. In addition a sum of £6,917 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 £1,120, of which £734 consisted of refunds of advances.

In 1921 there were 29 State batteries in operation. The amount expended thereon up to the end of 1921 was £91,981 from revenue and £302,090 from loan, giving a total of £394,071. During the year receipts amounted to £36,522, and working expenditure to £44,324.

The total value of gold and tin recovered to the end of 1921 at the State plants was £5,496,000, resulting from the treatment of 1,318,000 tons of gold ore and 80,000 tons of tin ore, together with a small amount from residues.

7. **Tasmania.**—During the year 1921, the sum of £5,261 was expended in aid to mining, including £475 for salaries, £106 for assay material, £803 assistance to prospectors, and advances of £2,194 and £1,200 to the No. 2 and No. 6 Argent Prospecting Syndicates respectively. The receipts amounted to £1,110 of which £1,050 represented royalty by tributera.

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

8. **Northern Territory.**—A sum of £1,634 was expended in 1920–21 in subsidies in aid of underground development, while aid granted to prospectors amounted to £855.

The Government maintains batteries at Marranboy and Hayes Creek, and the Government Assayer makes free assays for prospectors and others.

§ 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 registered with the Australian Metal Exchange.

§ 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 1918 to 1922 were as follows :—

REFINED METALS PRODUCED IN AUSTRALIA, 1918 TO 1922.

Metal.			1918.	1919.	1920.	1921.	1922.
Silver	..	ozs.	9,924,322	6,696,788	681,370	4,572,878	7,896,052
Lead, pig	..	tons	166,731	82,732	4,077	55,749	105,528
Zinc	..	tons	10,029	6,544	9,665	1,681	23,724
Copper	..	tons	44,018	16,182	24,069	18,600	11,524
Tin	..	tons	4,582	4,102	4,108	2,985	2,657

2. **Metallic Contents of Ores, Concentrates, etc., Exported.**—The estimated metallic contents of ores, concentrates, etc., exported during the five years 1918 to 1922 are given in the following table :—

METALLIC CONTENTS OF ORES, CONCENTRATES, ETC., EXPORTED, 1918 TO 1922.

Metal.		Contained in—	1918.	1919.	1920.	1921.	1922.
Silver	ozs. {	Lead—Silver—Gold Bullion	..	..	141,263	64,811	165,290
		Lead Concentrates	..	..	..	210,944	281,728
		Zinc Concentrates	5,666,609	1,161,754	980,891	456,317	3,390,964
		Total	5,666,609	1,161,754	1,122,154	732,072	3,837,982
Lead	tons {	Lead—Silver—Gold Bullion	..	..	1,939	580	1,790
		Lead Concentrates	..	..	4,122	3,950	2,959
		Zinc Concentrates	32,653	7,463	6,345	2,498	19,910
		Total	32,653	7,463	12,406	7,028	24,659
Zinc	tons {	Lead Concentrates	..	..	..	435	..
		Zinc Concentrates	23,335	20,608	24,242	19,181	135,690
		Total	23,335	20,608	24,242	19,616	135,690
Copper	tons	Ores, Matte, etc.	..	..	2,117	34	326
Tin	tons	Concentrates	..	..	70	5	..

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

The quantities and values of the principal metals, ores, and concentrates of Australian produce exported overseas as recorded by the Customs Department for the year 1921–22 were as follows :—Antimony ore, 712 tons, £15,001 (631 tons to United Kingdom); zinc, bars, blocks, slabs or cakes, 7,953 tons, £236,242 (1,000 tons to United Kingdom); zinc concentrates, 120,428 tons, £586,329 (46,331 tons to United Kingdom and 59,691 tons to Belgium); copper ingots, 9,382 tons, £704,988 (8,973 tons to United Kingdom); tin ingots, 1,774 tons, £284,357 (1,056 tons to United Kingdom and 503 tons to United States); lead, pig, 72,910 tons, £1,720,754 (54,902 tons to United Kingdom and 13,091 tons to Japan); lead, matte, 434 tons, £9,587 (424 tons to United Kingdom); silver and lead concentrates, 7,868 tons, £95,881 (2,521 tons to Belgium and 5,347 tons to Germany); platinum, osmium, iridium, etc., 1,907 ozs., £35,988 (746 ozs. to United Kingdom and 1,134 ozs. to United States); and pig iron, 1,140 tons, £11,738 (1,023 tons to New Zealand).