

## SECTION XII.

## MINES AND MINING.

## § 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, 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. In general, it may be said that the variety of Australian mineral wealth is very great.

**3. Quantity and Value of Production during 1919.**—The value of production from the mineral industry in 1919 shewed a decline of nearly £6,500,000 on that for the preceding year. In New South Wales, where there was a falling-off amounting to upwards of £4,000,000, the lessened output was chiefly due to the cessation of operations early in the year at the Broken Hill mines, and in part to the dry conditions prevailing over a large area of the State. The yield from copper in all the copper-producing States was also responsible for a diminution in the totals. This was especially the case in regard to Queensland and South Australia, where decreases of £1,135,000 and £600,000 respectively were recorded, the production from copper in the former State shewing a decline from over £2,000,000 to about £952,000, and in the latter from £828,000 to £229,000. Production in South Australia was to some extent hampered by shortage of fuel, the result of industrial troubles in other States.

The table hereunder and the succeeding one shew respectively the quantity of the various minerals produced during 1919 in each State, and the values apportioned thereto in the form in which the items were reported to the Mines Departments. The quantities and values given represent the amounts which the Departments consider may fairly be taken as accruing to the mineral industry as such. Thus, the item pig iron in New South Wales represents metal produced from locally raised ore only and so reported to the Mines Department. South Australia, as the table shews,

receives credit for ironstone in the crude stage, but the quantity and value of the pig iron produced therefrom in New South Wales cannot be taken as a product of the New South Wales mineral industry. 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. Information in regard to the quantity of *metal* extracted at the various smelting and refining works in the Commonwealth, together with that contained (estimated) in the ores, concentrates, &c., exported or sold for export, is given in §18 hereinafter.

### QUANTITIES OF PRINCIPAL MINERALS PRODUCED, COMMONWEALTH, 1919.

Minerals.	Unit.	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T. (d)	C'wealth.
Alunite ..	ton	2,435	..	..	60	..	..	..	2,545
Antimony ore ..	..	87	1,208	3	..	..	..	..	1,298
Asbestos ..	..	1,739	..	..	..	53	51	..	1,843
Bismuth ..	cwt.	390	..	2,888 (a)	..	1	35	..	3,264
Brown coal ..	ton	..	111,628	..	..	..	..	..	111,628
Chromite ..	..	250	..	..	..	..	..	..	250
Coal ..	..	8,631,554	423,945	931,631	..	401,713	66,253	..	10,455,096
Coke ..	..	424,773	..	..	..	..	..	..	424,773
Copper (ingot and matte) ..	..	1,460	..	9,997	2,517	4	5,071	..	19,049
Copper ore ..	..	..	..	(b)	(b)	455	..	159	614
Diatomaceous earth ..	..	88	140	..	..	..	..	..	228
Gold ..	fine oz.	65,839	135,428	121,030	3,224	734,066	7,686	829	1,068,102
Gypsum ..	ton	..	820	..	25,216	..	..	..	26,036
Iron (pig) (e)	..	80,941	..	..	..	..	..	..	80,941
Iron oxide ..	..	2,724	..	..	..	..	..	..	2,724
Ironstone ..	..	2,128	..	24,676	268,530	..	..	..	295,334
Kaolin ..	..	2,254	2,049	..	777	..	..	..	5,080
Lead ..	..	11,497	..	135	..	1,780	..	..	13,412
Lead and silver ore, concentrates, etc.	..	77,989	..	..	..	248	..	12	78,249
Limestone flux ..	..	83,032	..	86,436	45,398	..	..	..	214,866
Magnesite ..	..	9,264	77	..	273	..	..	..	9,614
Manganese ore ..	..	4,651	..	20	298	..	..	..	4,969
Molybdenite ..	cwt.	1,317	1,560	2,356	4	140	..	7	5,384
Phosphate ..	ton	576	2,491	..	5,950	..	..	..	9,017
Platinum ..	oz.	213	..	..	..	..	..	..	213
Pyritic ore ..	ton	..	..	..	..	4,136	3,457	..	7,593
Salt ..	..	..	(c)	..	69,174	..	..	..	69,174
Scheelite ..	..	80	..	13	..	6	199	..	298
Shale ..	..	25,453	..	..	..	..	600	..	26,053
Silver ..	fine oz.	1,232,710	6,121	92,048	561	223,332	..	..	1,554,772
Tin and tin ore ..	ton	2,692	113	994	318	1,580	162	..	5,859
Wolfram ..	..	135	2	229	..	..	121	201	688
Zinc concentrates ..	..	72,294	..	..	..	..	285	..	72,579

(a) Including 2,798 cwt. bismuth and wolfram. (b) Included with metal. (c) Not available for publication. (d) Year ended 30th June, 1919. (e) *Vide* letterpress preceding paragraph.

The comparative value of the production of minerals raised in each State during 1919 is given in the following table:—

### VALUE OF COMMONWEALTH MINERAL PRODUCTION IN 1919.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T.(c)	C'wealth.
	£	£	£	£	£	£	£	£
Alunite ..	14,910	..	..	246	..	..	..	15,156
Antimony ore ..	2,342	24,160	78	..	..	..	..	26,580
Asbestos ..	1,986	..	..	..	1,443	1,275	..	4,704
Bismuth ..	20,215	..	(a) 19,336	..	15	573	..	40,139
Brown coal ..	..	34,542	..	..	..	..	..	34,542
Chromite ..	616	..	..	..	..	..	..	616
Coal ..	5,422,846	372,075	614,307	..	270,355	47,004	..	6,726,587
Coke ..	550,127	..	..	..	..	..	..	550,127
Copper (ingot and matte) ..	139,296	..	952,501	228,930	365	557,710	..	1,878,802
Copper ore ..	..	..	(b)	(b)	9,740	984	2,349	13,073
Diamonds ..	1,706	..	..	..	..	..	..	1,706
Diatomaceous earth ..	246	560	..	..	..	..	..	806

(a) Including bismuth and wolfram, £18,681. (b) Included with metal. (c) Year ended 30th June, 1919.

VALUE OF COMMONWEALTH MINERAL PRODUCTION IN 1919—*continued.*

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T. (c)	C'wealth.
	£	£	£	£	£	£	£	£
Gems (unspecified) ..	..	..	42,883	..	..	..	..	42,883
Gold ..	336,240	691,632	618,101	16,465	3,748,882	39,252	4,234	5,454,806
Gypsum ..	..	482	..	18,725	..	..	..	19,207
Iron (pig) (e) ..	445,175	..	..	..	..	..	..	445,175
Iron oxide ..	3,406	..	..	..	..	..	..	3,406
Ironstone ..	2,072	..	27,684	307,402	..	..	..	337,158
Kaolin ..	3,243	2,255	..	1,463	..	..	..	6,961
Lead ..	324,215	..	4,739	..	48,462	..	..	377,416
Lead and silver- lead ore, concen- trates, &c. ..	1,030,825	..	(a)	..	3,704	136,234	132	1,170,895
Limestone flux ..	22,779	..	(d) 27,842	15,994	..	..	..	66,615
Magnesite ..	8,032	231	..	508	..	..	..	8,771
Manganese ore ..	13,953	..	103	1,490	..	..	..	15,546
Molybdenite ..	30,308	2,531	52,234	70	100	..	6	85,249
Opal ..	27,552	..	600	20,000	..	..	..	48,152
Phosphate ..	2,016	2,491	..	8,982	..	..	..	13,489
Platinum ..	3,150	..	..	..	..	..	..	3,150
Pyritic ore ..	..	..	..	..	4,919	4,288	..	9,207
Salt ..	..	(b)	..	138,348	..	..	..	138,348
Scheelite ..	15,193	..	2,331	..	772	43,181	..	61,477
Shale ..	37,968	..	..	..	..	900	..	38,868
Silver ..	292,838	1,607	23,772	180	55,342	..	..	373,739
Tin and tin ore ..	416,623	17,561	143,167	..	47,269	395,794	30,021	1,050,435
Wolfram ..	22,818	400	40,596	..	15	26,613	34,805	125,247
Zinc concentrates ..	247,395	..	..	..	..	13,110	..	260,505
Unenumerated ..	212,010	1,453	4,951	15,961	590	40,774	150	275,889
Total ..	9,652,101	1,151,980	2,575,225	774,764	4,191,973	1,307,692	71,697	19,725,432

(a) Included with metal. (b) Not available for publication. (c) Year ended 30th June, 1919.  
 (d) Portion of the limestone raised was used in the manufacture of lime and cement. (e) See  
 letterpress § 3.

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 1919 consist of—lime, £57,411; marble, £3,151; Portland cement, £379,896, and brick and pottery clays in the "unenumerated" class. Sulphuric acid to the value of £190,249 was produced in New South Wales in 1919. For South Australia the principal items in the unenumerated class are flint pebbles, £4,809; and barytes, £5,264; while the sulphur contents of the copper ores were valued at £3,105. The unenumerated class in Tasmania includes osmiridium to the value of £39,614.

4. Total Production to end of 1919.—In the next table will be found the estimated value of the total mineral production in each State up to the end of 1919. The figures given in this 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 £6,569,000 of that published by the State Department of Mines, the principal items excluded being cement, £4,657,000; lime, £591,000; and marble, £38,000.

## COMMONWEALTH MINERAL PRODUCTION TO END OF 1919.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor.Ter.(a)	C'wealth.
	£	£	£	£	£	£	£	£
Gold ..	62,704,761	300,017,938	83,297,451	1,584,634	141,360,396	8,758,381	2,263,400	599,986,961
Silver and lead ..	87,889,264	258,464	3,057,977	375,035	1,512,858	6,564,849	62,216	99,720,663
Copper ..	15,128,100	216,656	22,586,593	32,127,122	1,610,877	15,057,118	230,930	86,957,396
Iron ..	2,844,800	15,641	440,956	1,822,354	36,695	52,110	..	5,212,556
Tin ..	11,928,503	878,768	9,550,365	..	1,428,107	14,719,377	484,786	38,989,906
Wolfram ..	269,430	11,530	1,047,014	301	1,441	157,991	160,882	1,648,589
Zinc ..	13,194,545	..	..	15,993	5,437	35,986	..	13,251,961
Coal ..	98,144,265	4,638,735	8,779,956	..	2,823,911	948,268	..	114,835,135
Other ..	11,736,686	629,068	1,999,830	1,960,112	59,392	392,606	18,339	16,796,083
Total ..	303,840,354	306,666,800	130,760,192	37,885,551	148,339,114	46,686,686	3,220,553	977,390,250

(a) To 30th June, 1919.

The "other" minerals in New South Wales include alunite, £190,981; antimony, £341,183; bismuth, £189,042; chrome, £108,211; coke, £5,000,555; diamonds, £133,987; limestone flux, £854,638; molybdenite, £205,565; opal, £1,474,584; scheelite, £188,570; and oil shale, £2,502,413. In the Victorian returns antimony ore was responsible for £534,927. Included in "other" in the Queensland production were opal, £179,195; gems, other, £389,771; bismuth, £303,442; molybdenite, £336,801; and limestone flux, £561,631. The chief items in South Australian "other" minerals were salt, £1,117,297; and limestone flux, £201,548. Considerable values from gypsum and rock phosphates are also included. In the Tasmanian returns limestone flux was responsible for £91,739, and osmiridium for £122,377, while the figures for recent years include values for iron pyrites.

It will be convenient in the succeeding pages to deal first with gold and the various metals, then with non-metallic minerals and precious stones, and finally to furnish some account of the extent of employment in mining generally.

## (A) METALLIC MINERALS.

## § 2. Gold.

1. **Discovery of Gold 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 of Gold at Various Periods.**—In the following table will be found the value of the gold raised each year in the several States and in the Commonwealth 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.

In New South Wales the yield for 1919 was about 21,000 ozs. lower than in 1918, and was the lowest recorded since 1851. In Victoria the yield for 1919 shewed a decrease of 23,000 ozs. fine on that for the preceding year. In Queensland the yield in 1919 was over 12,000 ozs. less than in the preceding year. As in the case in other States where there is a diminishing production, the decline is due to the gradual depletion of the mines in the principal fields. The returns for South Australia for 1919 shew a decrease of nearly 3,000 ozs. on the previous year's output. For Western Australia the figures shew a decrease of over 142,000 ozs. in 1919, as compared

with 1918, diminished returns being recorded in the outputs from all the fields except Kimberley, Peak Hill, Yalgoo, Mount Margaret, Broad Arrow, and North-East Coolgardie. For Tasmania there was a decline of nearly 3,000 ozs.

### VALUE OF GOLD RAISED IN AUSTRALIA, 1851 TO 1919.

Year.	N.S.W.	Victoria.	Queensland.	S. Aust.	W. Aust.	Tasmania.	Nor. Ter.	C'wealth.
	£	£	£	£	£	£	£	£
1851	468,336	851,596	..	..	..	(b)28,737	..	1,348,669
1852	2,660,946	9,146,140	..	..	..	472,615	..	12,279,701
1853	1,781,172	10,976,392	..	..	..	217,538	..	12,975,102
1854	773,209	8,873,932	..	..	..	65,030	..	9,712,171
1855	654,594	11,277,152	..	..	..	(c)	..	11,931,746
1856	689,174	12,214,978	..	..	..	(c)	..	12,904,150
1857	674,477	11,320,852	..	..	..	1,146	..	11,996,475
1858	1,104,175	10,384,924	..	..	..	850	..	11,489,949
1859	1,259,127	9,894,812	..	..	..	2,188	..	10,656,127
1860	1,465,373	8,896,276	14,565	..	..	460	..	10,376,674
1861	1,806,172	8,140,692	3,928	..	..	32	..	9,950,824
1862	2,467,780	6,920,804	625	..	..	..	..	9,389,209
1863	1,796,170	6,779,276	14,802	..	..	..	..	8,590,248
1864	1,304,926	6,469,788	83,292	..	..	..	..	7,878,006
1865	1,231,243	6,446,216	92,938	..	..	..	..	7,770,397
1866	1,116,404	6,187,792	85,561	..	..	1,044	..	7,390,801
1867	1,053,578	6,005,784	189,248	..	..	4,382	..	7,252,992
1868	994,665	6,739,672	593,516	..	..	2,536	..	8,330,389
1869	974,149	6,179,024	523,045	..	..	514	..	7,676,732
1870	931,016	5,217,216	489,539	..	..	3,666	..	6,641,437
1871	1,250,485	5,475,768	616,907	(a)550,000	23,467	..	..	7,916,627
1872	1,644,177	5,325,508	660,396	6,363	27,314	..	..	7,663,758
1873	1,396,375	4,681,588	717,540	293	18,390	..	..	6,814,186
1874	1,041,614	4,390,572	1,356,071	4,175	18,491	..	..	6,810,923
1875	877,694	4,273,668	1,498,433	7,034	11,982	..	..	6,668,811
1876	613,190	3,855,040	1,438,111	9,888	44,923	..	..	5,961,152
1877	471,448	3,238,612	1,317,265	..	23,289	..	..	5,050,614
1878	480,200	3,032,160	1,149,240	1,225	100,000	..	..	4,712,825
1879	407,219	3,035,788	1,034,216	90	230,895	(d)52,500	..	4,760,708
1880	444,252	3,316,484	944,869	..	201,297	(e)26,522	..	4,933,424
1881	573,582	3,333,512	957,570	880	216,901	111,945	..	5,194,390
1882	526,522	3,458,440	785,868	4,634	187,337	80,720	..	5,043,521
1883	458,530	3,121,012	736,810	10,534	176,442	77,195	..	4,580,523
1884	396,059	3,114,472	1,062,471	15,469	160,404	77,935	..	4,826,810
1885	378,665	2,940,872	1,062,514	18,295	155,309	70,414	..	4,626,069
1886	366,294	2,660,784	1,187,189	32,535	117,250	63,139	..	4,428,339
1887	394,579	2,471,004	1,481,990	72,003	185,517	68,775	..	4,665,401
1888	317,241	2,500,101	1,690,477	34,205	132,73	147,154	..	4,737,256
1889	434,784	2,599,352	2,695,629	37,305	58,871	119,703	..	5,852,983
1890	460,285	2,354,240	2,182,563	20,808	86,664	75,888	..	5,260,972
1891	559,231	2,305,596	2,030,312	27,380	115,182	145,459	..	5,281,309
1892	575,290	2,617,824	2,164,391	26,097	226,284	158,917	..	5,877,575
1893	651,286	2,684,504	2,167,794	12,561	421,385	141,326	..	6,186,966
1894	1,156,717	2,867,816	2,330,232	33,401	787,099	217,024	..	7,501,731
1895	1,315,929	2,960,344	2,150,561	26,060	879,748	206,115	..	7,641,491
1896	1,073,360	3,220,348	2,132,979	14,350	1,068,808	237,574	..	7,828,597
1897	1,104,315	3,251,064	2,552,668	39,020	2,564,977	296,660	..	9,889,728
1898	1,201,743	3,349,028	2,750,348	10,676	3,990,698	291,496	..	11,678,456
1899	1,623,320	3,418,000	2,838,446	15,582	6,246,732	327,545	..	14,533,084
1900	1,070,920	3,229,628	2,871,578	14,494	6,007,611	316,220	..	13,578,145
1901	737,164	3,102,753	2,541,764	16,613	7,235,653	295,176	..	14,017,508
1902	684,970	3,062,028	2,730,512	24,828	7,947,661	301,573	..	14,811,823
1903	1,080,029	3,259,482	2,839,801	28,650	8,770,719	254,403	..	16,302,731
1904	1,146,109	3,252,045	2,714,934	76,025	8,424,226	280,015	..	15,935,118
1905	1,165,013	3,173,744	2,517,295	45,853	8,305,654	312,380	..	15,571,331
1906	1,078,866	3,280,478	2,313,464	27,000	7,622,749	254,963	..	14,626,384
1907	1,050,730	2,954,617	1,978,938	20,540	7,210,749	277,607	..	15,514,762
1908	954,854	2,849,838	1,975,554	12,300	6,999,882	242,482	..	13,058,852
1909	869,546	2,778,956	1,935,178	30,206	6,776,274	190,201	..	12,611,267
1910	802,211	2,422,745	1,874,955	28,000	6,246,848	157,370	..	11,557,650
1911	769,353	2,140,855	1,640,323	15,000	5,823,075	132,108	..	10,551,624
1912	702,129	2,039,464	1,477,979	28,000	5,448,385	161,300	..	9,879,928
1913	635,703	1,847,475	1,128,768	27,800	5,581,701	141,876	..	9,376,573
1914	528,873	1,755,236	1,059,674	26,581	5,237,353	111,475	..	8,728,946
1915	562,819	1,397,793	1,060,703	25,830	5,140,228	78,784	(f)3,781	8,269,938
1916	459,370	1,090,194	913,951	33,000	4,608,532	67,072	(g)3,661	7,075,980
1917	349,038	857,500	761,639	30,334	4,121,645	61,577	(g)3,677	6,185,410
1918	369,743	674,655	567,371	26,252	3,723,183	44,724	(g)2,229	5,408,157
1919	336,240	691,632	618,101	16,465	3,748,882	39,252	(g)4,234	5,454,806
Total	62,704,761	300,017,938	83,297,451	1,584,634	141,360,896	8,758,381	2,263,400	599,986,961

(a) Mines Department estimate of gold production to 1871. (b) Including gold dust to the value of £3,920 exported in 1850. (c) Not available. (d) Estimate prior to 17th August, 1880. (e) 17th August to 31st December, 1880. (f) 1st January to 30th June. (g) Year ended 30th June.

The amount of gold raised in the Commonwealth in any one year attained its maximum in 1903, in which year Western Australia also reached its highest point. For the other States of the Commonwealth 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 the Commonwealth during each of the last ten years, the value of one ounce fine being taken at £4 4s. 11 $\frac{1}{4}$ d., except in 1919, when it was taken as £5 2s. 1 $\frac{1}{2}$ d. :—

QUANTITY OF GOLD PRODUCED IN THE COMMONWEALTH, 1910 TO 1919.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tasmania.	Nor. Ter.	C'wealth.
	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
1910 ..	188,856	570,363	441,402	6,592	1,470,633	37,048	6,008	2,720,902
1911 ..	181,121	504,000	386,165	3,531	1,370,868	31,101	7,277	2,484,063
1912 ..	165,295	480,131	347,946	6,592	1,282,659	37,973	5,337	2,325,933
1913 ..	149,657	434,933	265,735	6,545	1,314,044	33,400	3,119	2,207,433
1914 ..	124,507	413,218	249,468	6,258	1,232,978	26,243	2,296	2,054,968
1915 ..	132,498	329,068	249,711	6,081	1,210,113	18,547	(a) 890	1,946,908
1916 ..	108,145	256,653	215,162	7,769	1,061,399	15,790	(b) 909	1,665,827
1917 ..	82,170	201,873	179,305	7,141	970,318	14,496	(b) 866	1,456,169
1918 ..	87,045	158,827	133,570	6,180	876,512	10,529	(b) 525	1,273,188
1919 ..	65,839	135,428	121,030	3,224	734,066	7,686	(b) 829	1,068,102

(a) 1st January to 30th June.

(b) Year ended 30th June.

3. *Changes in Relative Positions of States as Gold Producers.*—A glance at the figures in the table shewing 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 the Commonwealth. New South Wales occupied the second place on the list until 1874, when Queensland returns exceeded those of the parent State, a condition of things that has been maintained ever since. South Australia has occupied the position of lowest contributor to the total gold yield of the Commonwealth 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 the Commonwealth was as follows :—

RELATIVE POSITION OF STATES AS GOLD PRODUCERS, 1910 TO 1919.

State.	Annual Average of Gold Production, 1910 to 1919.	Percentage on Commonwealth.	State.	Annual Average of Gold Production, 1910 to 1919.	Percentage on Commonwealth.
	Ozs.			Ozs.	
Commonwealth ..	1,920,349	100·0	New South Wales ..	128,513	6·7
Western Australia ..	1,152,359	60·0	Tasmania ..	23,281	1·2
Victoria ..	348,450	18·2	South Australia ..	5,991	0·3
Queensland ..	258,949	13·5	Northern Territory	2,806	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 Tibbooburra, and detrital gold has been found in permo-carboniferous conglomerates at Tallawang. The method of dredging is at present being 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 1,899 ozs. in 1919, the chief yields being—Peak Hill, 248 ozs.; Hill End, 243 ozs.; Windeyer, 140 ozs.; Major's Creek, 122 ozs.; Sofala, 158 ozs.; Mudgee, 150 ozs.; and Mt. McDonald, 100 ozs. The quantity obtained by dredging was 21,050 ozs.; the largest returns being obtained at Araluen, 3,172 ozs.; Adelong, 8,023 ozs.; and Gundagai, 7,851 ozs. The dredges in operation during 1919 numbered 77, of which 16 were of the bucket type and 61 were suction plants. In the recovery of gold 14 bucket dredges and 1 pumping plant were employed, while 2 bucket dredges and 60 pumping plants were engaged in the winning of stream tin. The value of the plants in operation was estimated at £416,459. The quantity of gold won from quartz amounted to 23,086 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 1,403 ozs. and 5,928 ozs. Next come the Hillgrove field with 4,345 ozs.; Hill End, 3,400 ozs.; and Gundagai, 1,567 ozs.

The table below shews as far as can be ascertained the yield from alluvial and quartz mining in each of the principal districts during 1919. Owing to the circumstance that it was impossible to obtain complete returns from all the mine and battery owners the total for the State necessarily falls short of that given in preceding pages.

#### GOLD WON IN NEW SOUTH WALES, ALLUVIAL AND QUARTZ, 1919.

District.	Alluvial.		Quartz.	Total.
	Other than by Dredging.	By Dredging.		
	Ozs.	Ozs.	Ozs.	Ozs.
Albert .. .. .	21	..	3	24
Bathurst .. .. .	318	..	1,880	2,198
Clarence and Richmond .. .. .	60	..	93	153
Cobar .. .. .	..	..	7,420	7,420
Hunter and Macleay .. .. .	..	..	322	322
Lachlan .. .. .	16	7,851	2,793	10,660
Mudgee .. .. .	557	..	1,338	1,895
New England .. .. .	33	3	..	36
Peel and Uralla .. .. .	175	37	4,457	4,669
Southern .. .. .	132	3,176	1,308	4,616
Tambaroora and Turon .. .. .	462	..	3,412	3,874
Tumut and Adelong .. .. .	125	8,206	60	8,391
Total .. .. .	1,899	19,273	23,086	44,258

(ii) *Victoria.* Lode mining predominates in Victoria, although gold is also obtained from alluvial workings, both surface and deep leads. The deepest mines in Australia are found in the Bendigo district, where there are two shafts 4,614 and 4,318 feet deep respectively. Altogether there were some few years ago no less than fifty-three shafts in this district which had reached a depth of over 2,000 feet. A considerable amount of attention is given to dredging and hydraulic sluicing, particularly in the Beechworth, Maryborough, Castlemaine, Ararat, Stawell, Gippsland, and Ballarat districts, the number of plants in operation at the end of 1919 being 56, of which 16

were bucket dredges, 7 pumps, 27 jet elevators, and 6 sluicing by gravitation. The total quantity of gold won by dredging and sluicing in 1919 was 24,540 ozs. Tin to the value of £16,456 was also won. The yields from alluvial workings and quartz reefs, as returned (in crude ounces) from the chief mining districts of the State during last year, were as follows:—

#### GOLD WON IN VICTORIA, ALLUVIAL AND QUARTZ, 1919.

District.				Alluvial.	Quartz.	Total.
				Ozs.	Ozs.	Ozs.
Ararat and Stawell	..	..	..	3,864	5,174	9,038
Ballarat	..	..	..	4,356	3,583	7,939
Beechworth	..	..	..	22,983	7,962	30,945
Bendigo	..	..	..	826	63,823	64,649
Castlemaine	..	..	..	6,543	9,857	16,400
Gippsland	..	..	..	3,126	3,364	6,490
Maryborough	..	..	..	4,964	604	5,568
Total	..	..	..	46,662	94,367	141,029

The largest output from lode mines in 1919 was furnished by the Constellation (Bendigo) with 16,390 ozs., followed by the Carlisle and Great Northern in the same area, which yielded respectively 5,242 and 4,884 ozs. It was hoped that the consolidation of the mines in the "Central area" at Bendigo would result in a more extended treatment of the low-grade ore. No great development, has, however, taken place in this direction, and the success of the Bendigo Amalgamated Goldfields Co. which controls and works nearly all the mines has been due to the high-grade quartz raised from the Constellation mine, where 14,772 tons gave a yield of 16,390 ozs. Of the deep alluvial mines the Chiltern Valley (Beechworth) produced 4,158 ozs. In dredging, Cock's Pioneer, at Beechworth, was the most successful, with 7,593 ozs. Tin ore to the value of upwards of £15,000 was also won by this company.

(iii) *Queensland.* Operations in Queensland are at present 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 1919 being only 376 ozs., while the quantity produced from stone treated was 28,627 ozs.; from copper and other ores 90,981 ozs.; and from old tailings 1,046 ozs.; making a total production of 121,030 ozs. The yields from the principal fields are given below:—

#### GOLD WON IN QUEENSLAND, ALLUVIAL AND QUARTZ, 1919.

District.				Alluvial.	From Stone Treated.	From Copper and other Ores and old Tailings.	Total.
				Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
Charters Towers	..	..	..	25	8,070	..	8,095
Gympie	..	..	..	..	14,204	335	14,539
Mount Morgan	..	..	..	23	104	89,778	89,905
Ravenswood	..	..	..	9	451	15	475
Croydon	..	..	..	..	..	670	670
Etheridge, Oaks and Woolgar	..	..	..	75	1,955	4	2,034
Cloncurry	..	..	..	..	..	969	969
Gladstone	..	..	..	58	65	202	325
Clermont	..	..	..	36	1,575	..	1,611
Chillagoe	..	..	..	..	1,638	..	1,638
Mount Peter	..	..	..	..	388	..	388
Other districts	..	..	..	150	177	54	381
Total	..	..	..	376	28,627	92,027	121,030

As shewn in the table the Mount Morgan field easily takes first place amongst Queensland gold-producing areas. During 1919 this field also produced copper to the value of over £506,000.



(iv) *South Australia.* In South Australia alluvial gold has been worked for many years in the gullies round Adelaide, while a fair amount of gold has been obtained by this method at Teetulpa, in the northern area. The battery and cyanide returns as published in the *Mining Review* show that the chief producing centres in 1919 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 unoxidised portions of the lodes, and often also with copper pyrites, arsenical pyrites and galena. Tellurides of gold occur at times. The principal auriferous rocks are of very great geological age, most probably pre-Cambrian, and possibly Archæan, and have all been subjected to intense metamorphism. It is found that the rich veins are not restricted to any one particular description of rock—granite, quartz, porphyry, quartz dolerite, diorite, &c., and even metamorphic sedimentary country rock, have been found to carry them in various parts of the State. The total production of gold from all sources during 1919 was 734,066 ounces, of which only about 0.1 per cent. was alluvial. The yields in each district were as shewn below :—

#### GOLD WON IN WESTERN AUSTRALIA, ALLUVIAL, QUARTZ, ETC., 1919.

Goldfields.	Alluvial.	Dolled and Specimens.	Crushed.	Total.
	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
East Coolgardie .. .. .	202	568	396,285	397,055
East Murchison .. .. .	..	148	27,266	27,414
Mount Margaret .. .. .	39	353	87,760	88,152
Murchison .. .. .	72	1,214	49,284	50,570
North Coolgardie .. .. .	42	550	22,427	23,019
Coolgardie .. .. .	175	102	5,537	5,814
Phillips River .. .. .	..	7	1,693	1,700
North-east Coolgardie .. .. .	19	221	5,232	5,472
Yilgarn .. .. .	2	..	54,001	54,003
Broad Arrow .. .. .	70	1,266	10,393	11,729
Peak Hill .. .. .	24	39	2,192	2,255
Pilbara .. .. .	169	35	3,217	3,421
Dundas .. .. .	..	1,118	11,412	12,530
Yalgoo .. .. .	..	72	4,716	4,788
West Pilbara .. .. .	26	..	69	95
Kimberley .. .. .	151	..	..	151
Other goldfields .. .. .	..	46	..	46
Total .. .. .	991	5,739	681,484	688,214

The figures in the previous table are compiled from returns from the individual mines, and are somewhat incomplete; the total is therefore less than that shewn on page 341, which represents mint and export returns.

(vi) *Tasmania*. The yield from Tasmania in gold mining is chiefly obtained from quartz reefing, and the returns from each district in 1919 are given below:—

#### GOLD WON IN TASMANIA, 1919.

District.	Total.	District.	Total.
	Ozs.		Ozs.
Beaconsfield .. ..	572	Lisle .. ..	110
Mathinna .. ..	1,529	Golconda .. ..	101
Mt. Victoria .. ..	376	Mt. Claude .. ..	5,466
Warrentinna .. ..		North-West and West Coasts	
Mt. Cameron .. ..			
Lefroy .. ..	3	Total .. ..	8,157

The total production was equal to 7,686 ozs. fine. During 1919 the blister copper produced by the Mt. Lyell Mining and Railway Co. Ltd. contained approximately 5,251 ozs. of gold.

(vii) *Northern Territory*.—The principal yields in 1919 were returned from Bridge Creek, 545 ozs., and Ambrookville, 317 ozs. Small quantities were produced also at Fletcher's Gully and Tanami.

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

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

7. *Place of the Commonwealth 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 the Commonwealth therein during the ten years 1910 to 1919. 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.

#### WORLD'S GOLD PRODUCTION, 1910 TO 1919.

Year.	World's Production of Gold.	Gold Produced in Commonwealth.	Percentage of Commonwealth on Total.
	£	£	%
1910 .. ..	93,341,573	11,557,650	12.38
1911 .. ..	95,541,042	10,551,624	11.04
1912 .. ..	96,854,583	9,879,928	10.20
1913 .. ..	93,102,674	9,376,573	10.07
1914 .. ..	91,300,350	8,728,946	9.56
1915 .. ..	95,711,619	8,269,938	8.64
1916 .. ..	92,568,926	7,075,980	7.64
1917 .. ..	88,526,271	6,185,410	6.99
1918 .. ..	77,630,366	5,408,157	6.98
1919 .. ..	93,804,949	5,454,806	5.82

While the production of gold in the Commonwealth shews a considerable decrease during the twenty years from 1897 to 1919, the world's total production increased by over 94 per cent. in the same period. The following table will be found interesting as shewing the various foreign countries where the chief increases have taken place during the interval in question :—

GOLD YIELD, VARIOUS COUNTRIES, 1897 TO 1919.

Country.	1897.	1900.	1917.	1918.	1919.
	£	£	£	£	£
United States ..	11,787,000	16,269,000	16,912,000	13,841,000	14,905,000
Canada ..	1,240,000	5,742,000	3,138,000	2,972,000	3,916,000
Costa Rica ..	2,000	31,000	200,000	161,000	179,000
Colombia ..	..	..	1,031,000	958,000	4,021,000
Transvaal ..	11,654,000	1,481,000	38,306,000	35,759,000	42,548,000
Rhodesia ..	800	308,000	3,544,000	2,682,000	3,030,000
Gold Coast ..	85,000	38,000	1,549,000	1,338,000	1,508,000
Madagascar ..	8,500	142,000	126,000	88,000	92,000
India ..	1,571,000	1,893,000	2,222,000	2,060,000	1,504,000
Corea ..	208,000	371,000	691,000	604,000	604,000a
Japan ..	142,000	290,000	1,185,000	1,159,000	1,159,000a
Netherlands East Indies	24,000	112,000	529,000	431,000	392,000

(a) 1918 figures.

The largest increase amongst the more important producing countries was recorded in the Transvaal, where the production was nearly four times as great in 1919 as in 1897. During the last three years, however, as the table shews, there has been a general decline, except in Canada, Colombia, and Transvaal.

The next table shews the average yearly value in order of importance of the yield in the chief gold producing countries for the decennium 1910-19.

AVERAGE ANNUAL VALUE, GOLD YIELD, CHIEF PRODUCING COUNTRIES, 1910 TO 1919.

Country.	Value.	Country.	Value.
	£		£
Transvaal ..	37,346,000	Canada ..	3,128,000
United States ..	18,091,000	India ..	2,260,000
Australasia ..	9,584,000	Gold Coast ..	1,450,000
Commonwealth ..	8,249,000	Colombia ..	1,287,000
Russia ..	5,082,000	New Zealand ..	1,286,000
Mexico ..	3,499,000	Japan ..	1,098,000
Rhodesia ..	3,165,000		

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 shewn in the following table :—

PERSONS EMPLOYED IN GOLD MINING, 1901 AND 1915 TO 1919.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.	C'wealth.
	No.	No.	No.	No.	No.	No.	No.	No.
1901 ..	12,064	27,387	9,438	1,000	19,771	1,112	200	70,972
1915 ..	2,888	8,755	2,766	200	11,323	215	99	26,246
1916 ..	2,317	6,402	1,900	150	9,824	176	99	20,868
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

### § 3. Platinum and the Platinoid Metals.

**Platinum.**—(i) *New South Wales.* The existence of platinum was first noted in New South Wales in 1851 by Mr. S. Stutchbury, who found a small quantity near Orange. Since the year 1878 small quantities of the metal have been obtained from beach sands in the northern coastal district. Platiniferous ore was noted in 1889 at Broken Hill. The principal deposits at present worked in the State are situated at Platina in the Fifield division, near Parkes, and the production in 1919 amounted to 213 ozs., valued at £3,150, while the total production recorded for the period 1894–1919 amounted to 14,893 ozs., valued at £47,734. The production in 1919 was only about a third of that in the preceding year, the falling-off being due to lack of water for treating the wash-dirt.

At Platina, gold is found in association with the platinum, and it is estimated that there are 200 acres of metalliferous country sufficiently rich to yield a satisfactory return, provided it were worked on a large scale with an abundant water supply. Small quantities of the metal are obtained in beach mining in the Ballina Division.

(ii) *Victoria.* In Gippsland, Victoria, the metal has been found in association with copper. The production of platinum in 1913 amounted to 127 ozs., and was contained in matte produced by the Gippsland Copper, Platinum, and Gold Mining and Smelting Company, from ores raised from the old mine at Cooper's Creek. There was no production during the last six years.

(iii) *Queensland.* Platinum associated with osmiridium has been found in the beach sands between Southport and Currumbin, in creeks on the Russell goldfield near Innisfail, and in alluvial deposits on the Gympie goldfield.

**2. Osmium, Iridium, etc.** (i) *New South Wales.* Small quantities of osmium, iridium, and rhodium are found in various localities. As far back as 1860, the Rev. W. B. Clarke stated that he found native iridium. Platinum, associated with iridium and osmium, has been found in the washings from the Aberfoil River, about 15 miles from Oban; on the beach sands of the northern coast; in the gem sand at Bingara, Mudgee, Bathurst, and other places. In some cases, as for example in the beach sands of Ballina, the osmiridium and other platinoid metals amount to as much as 40 per cent. of the platinum, or about 28 per cent. of the whole metallic content.

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

(iii) *Tasmania.* For many years osmiridium has been known to exist in the bed of the Savage River, on the West Coast, and in rivulets and creeks in the serpentine country, but it was not until early in 1911 that efforts were made to work the deposits. During that year the price paid for the mineral reached £7 10s. per oz., and about 100 men were engaged in the search for it. The quantity produced amounted to 271 ozs., valued at £1,188. In 1912 the production was 779 ozs., valued at £5,742, or an average of £7 7s. 9d. per oz. The yield in 1918 amounted to 1,607 ozs., valued at £44,833, and in 1919 to 1,670 ozs., valued at £39,614. During 1919 the metal won was obtained from the Savage River, Mt. Stewart, and Wilson River districts. Small quantities also are being obtained in the Dundas district. Owing to the war the market in 1914 was for a time closed, but a parcel of 13 ozs. forwarded to America was sold at an average of £5 13s. 6d. per oz. The declining production in 1915 and 1916 was due to difficulty in disposing of the metal. In 1917 the price increased from £11 to £18 10s. per oz., and for selected parcels £22 10s. per oz. was paid, while in 1918 the remarkable price of £37 5s. per oz. was reached. The average price in 1919 was £23 14s. 5d. per oz. Besides a steady and increasing use in the manufacture of fountain pens there is a demand for iridium and osmiridium for hard platinum jewellery.

## § 4. Silver.

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.**—In illustration of the development of silver mining in Australia the following table has been compiled, shewing the production of silver, silver-lead and ore, and lead from each State during the years 1881, 1891, 1901, and the five years ending 1919 :—

## PRODUCTION OF SILVER AND LEAD, AUSTRALIA, 1881 TO 1919.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.	C'wealth.
	£	£	£	£	£	£	£	£
1881 ..	14,651	5,021	13,494	1,182	£1,224	50	..	45,622
1891 ..	3,621,614	6,277	50,000	1,787	250	52,284	4,140	3,736,352
1901 ..	1,954,964	6,657	69,234	3,196	7,609	206,228	710	2,248,598
1915 ..	3,321,101	1,771	34,610	902	63,629	91,689	(a)	3,513,702
1916 ..	4,084,623	3,338	50,588	5,173	109,221	153,796	(b) 1,068	4,407,807
1917 ..	5,110,096	1,406	55,181	12,351	178,872	152,122	(b) 275	5,510,303
1918 ..	5,739,509	1,319	36,645	10,492	189,636	127,176	(b) 200	6,104,977
1919 ..	1,647,878	1,607	28,511	180	107,508	189,967	(b) 132	1,975,783

(a) 1st January to 30th June.

(b) Year ended 30th June.

The heavy falling-off in the production for 1919 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.

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 considered, therefore, that the State should not take full credit for the finished product. Hence the *net* value referred to above relates to that of the ore, concentrates, and bullion, as declared by the several companies to the Customs Department at date of export. 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 contents by average assay of concentrates exported during the last five years, will shew, as regards New South Wales, the estimated total production and the value accruing to the Commonwealth from the three metals :—

## TOTAL PRODUCTION FROM SILVER-LEAD MINES OF NEW SOUTH WALES, 1915 TO 1919.

Year.	Metal Produced within Australia.				Contents of Concentrates exported.			
	Silver.	Lead.	Zinc.	Value.	Silver.	Lead.	Zinc.	Value.
1915 ..	ozs. fine. 5,302,199	tons. 101,090	tons. 5,308	£ 3,267,736	ozs. fine. 1,710,058	tons. 9,819	tons. 71,049	£ 1,051,849
1916 ..	6,382,518	128,438	5,277	5,238,276	1,725,374	10,428	69,141	1,139,607
1917 ..	7,562,286	138,006	4,694	5,765,094	983,693	0,181	43,912	688,934
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

(a) Including 169 tons of Zinc Oxide valued at £3,112.

The figures given above are quoted on the authority of the Mines Department of New South Wales, which in the year 1918 amended the totals for silver previously published for the years 1915-17, while in 1919 considerable modifications were made in the figures relating to quantity and value of concentrates exported.

3. **Chief Centres of Silver 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 1915–8 the ore raised averaged over 1,200,000 tons, but, owing to the cessation of operations through industrial troubles the production in 1919 dwindled to 415,400 tons.

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

#### RETURNS OF BROKEN HILL SILVER MINES TO END OF 1919.

Mine.	Authorised Capital.	Value of Output to end of 1919.	Dividends and Bonuses Paid to end of 1919.
	£.	£	£
Broken Hill Proprietary Co. Ltd. . . . .	3,000,000	(a)48,194,848	11,865,887
Broken Hill Proprietary Block 14 Co. Ltd. . . . .	155,000	3,878,183	622,660
British Broken Hill Proprietary Co. Ltd. . . . .	339,000	4,779,254	821,280
Broken Hill Proprietary Block 10 Co. Ltd. . . . .	1,000,000	4,885,102	1,407,500
Sulphide Corporation Ltd. (Central Mine) . . . . .	1,050,000	(b)20,608,024	2,709,375
Broken Hill South Silver Mining Co. . . . .	800,000	10,050,501	2,535,000
North Broken Hill Mining Co. Ltd. . . . .	600,000	6,495,775	1,978,940
Broken Hill Junction Lead Mining Co. . . . .	150,000	1,143,723	87,500
Junction North Broken Hill Mine . . . . .	375,000	2,631,520	152,735
The Zinc Corporation Ltd. . . . .	(c)	2,973,102	10,000
Barrier South Ltd. . . . .	168,000	151,517	50,000
Totals . . . . .	7,637,000	(b)105,791,549	22,240,877

(a) The value of the ores purchased during the years 1908 to 1914 is not included. understated owing to incomplete returns.

(c) Not available.

(b) Output

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.

(b) *Yerranderie.* The mines in the Yerranderie division in the Southern Mining District produced 286,955 ozs. of silver in 1919, besides 714 ozs. of gold, and 861 tons of lead, the total production being valued at £78,528.

(c) *Cobar.* A considerable quantity of silver is obtained from the Great Cobar Mine and attached properties, the production in 1914 amounting to 24,305 ozs. Owing to the dislocation of the industry caused by the war the yield in 1915 fell to 1,838 ozs., but it rose again in 1916 to nearly 48,000 ozs., and in 1918 to 98,000 ozs. In 1919, however, the return fell to 18,000 ozs.

(d) *Sunny Corner.* In this division of the Bathurst Mining District 60,000 ozs. of silver, valued at £12,050, were produced during 1919.

(e) *Orange Division.* From the Lewis Ponds mine in this division of the Bathurst Mining District ore containing about 29,000 ozs. of silver, valued at £6,000, was raised in 1919.

(f) *Other Areas.* Small quantities were produced during the year in the Condobolin division of the Lachlan District, in the Hillgrove and Tingha divisions of the Peel and Uralla Mining District, from Leadville in the Mudgée division, from the Tumbaramba area in the Tumut and Adelong District, and in the New England Mining District.

(ii) *Tasmania.* The silver produced in 1919 amounted to 525,343 ozs., valued at £125,564, and the lead to 2,357 tons, valued at £64,403. The principal producers of

silver were the Magnet Mines, with a yield of 98,625 ozs.; the Zeehan Mines, 73,919 ozs.; Mt. Claude, 51,994 ozs.; and Mt. Farrell, 42,960 ozs. Lead to the amount of 808 tons was produced by the Zeehan Mines; 528 tons by the Magnet Mines; 447 tons by the North Mt. Farrell, and 365 tons by the Mt. Claude Mines.

(iii) *Queensland.* The yield for the chief silver-producing centres in 1919 was as follows:—Cloncurry, silver £3,947; Etheridge, silver £1,258, lead £2,030; Mt. Morgan, silver £5,606; Herberton, silver £5,175; Stanthorpe, silver £1,176. Towards the end of the year 1918 a discovery of argentiferous lead ore was made at Indooroopilly, one of the suburbs of Brisbane. This deposit yielded 60 tons of lead, valued at £2,117, and 10,082 ozs. of silver, valued at £2,604.

(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 highly mineralized, but, so far, has not been thoroughly prospected. The production of silver in 1919 was practically negligible.

(v) *Western Australia.* The quantity of silver obtained as a by-product and exported in 1919 was 223,332 ozs., valued at £55,342. In addition, lead and silver-lead to the value of £3,704, and 1,780 tons of pig lead, valued at £48,462, were exported.

(vi) *Northern Territory.* Silver-lead ores are found near Pine Creek, and at Mount Shoebridge near Brock's Creek railway station. Production in 1919 was small, amounting to a little over 12 tons, valued at £132.

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

#### WORLD'S PRODUCTION OF SILVER, 1910 TO 1919.

Year .. ..	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.
World's production in 1,000 fine ozs. (a)	240,223	254,214	250,979	214,391	171,429	185,443	168,693	174,188	197,394	174,517 (b)

(a) Add 000 to figures for fine ounces.

(b) Incomplete.

The Commonwealth's share in the world's silver production in 1919 was estimated at 7,000,000 ounces, or about 4 per cent. on the total production, as compared with 11,000,000 ounces, or about 6 per cent of the total in 1918, the falling-off being due to the lessened production from the Broken Hill field resultant on industrial disturbances. The figures, for the last three years which are given on the authority of *The Mineral Industry*, have been considerably amended since the last issue.

According to returns furnished by the secretary of the Australian Metal Exchange silver to the amount of 6,685,000 ozs. was extracted in Australia during 1919, while concentrates exported or sold for export were estimated to contain 1,162,000 ozs.

5. *Prices of Silver.*—As the production of silver is dependent to a very large extent on the price realised, a statement of the average price per standard ounce in the London market at various periods and during the last seven years is given below:—

#### PRICE OF SILVER, 1881 TO 1919.

Year .. ..	1881.	1891.	1901.	1911.	1914.	1915.	1916.	1917.	1918.	1919.
Pence per standard oz. ..	51 $\frac{1}{2}$	45 $\frac{1}{4}$	27 $\frac{1}{2}$	24 $\frac{1}{2}$	25 $\frac{1}{2}$	23 $\frac{1}{2}$	31 $\frac{1}{2}$	40 $\frac{1}{2}$	47 $\frac{1}{2}$	57 $\frac{1}{2}$

During the month of November, 1906, owing to the small sales in New York, and also to the fact that the Indian, American, and Mexican Governments were all buying silver, the price rose to 33½d., the highest realised since 1893, when the average stood at 36  $\frac{1}{2}$ d. The high average in 1917 was succeeded by a further rise to 47½d. in 1918, the monthly averages ranging from 43.2d. in March to 49½d. in September and October. Prices in 1919 shewed a sensational rise. Beginning with an average of about 48d. 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.

6. **Employment in Silver Mining.**—The number of persons employed in silver mining in 1901 and during each of the last five years is given below :—

**(NUMBER OF PERSONS EMPLOYED IN SILVER MINING, 1901 AND 1915 TO 1919.**

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tasmania.	Nor. Ter.	C'wealth.
	No.	No.	No.	No.	No.	No.	No.	No.
1901 ..	6,298	..	40	150	..	2,414(a)	(b)	8,902(c)
1915 ..	5,564	..	49	25	70	519	86	6,313
1916 ..	6,461	..	62	25	(d)244	555	86	7,433
1917 ..	7,619	..	71	..	(d)328	646	33	8,697
1918 ..	7,585	..	98	..	(d)382	631	10	8,706
1919 ..	6,556	..	145	..	74	798	3	7,576

(a) Including copper miners. (b) Included in South Australia. (c) Including copper miners in Tasmania. (d) Lead ore.

As the table shews, 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.

## § 5. Copper.

1. **Production of Copper.**—The production of copper in the various States of the Commonwealth 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 in earlier years and for 1915 to 1919 are shewn in the following tables :—

**PRODUCTION OF COPPER, AUSTRALIA, 1881 TO 1919.**

State.	1881.	1891.	1901.	1908.	1915.	1916.	1917.	1918.	1919.
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------

**QUANTITY.**

	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
N.S.W. { Ingot & Matte	4,124	2,363	6,087	2,679	2,463	5,617	6,576	6,510	1,460
{ Ore .. ..	1	347	645	392	4,510	554	..	..	..
Victoria { Ingot & Matte	583	60	983	..	..	..	..	..	..
{ Ore .. ..	331	85	3,087	14,698	19,704	19,520	19,062	18,980	9,997
Q'land { Ingot & Matte	..	35	1,997	..	..	..	..	..	..
{ Ore .. ..	3,824	3,592	9,741	5,628	7,725	7,279	7,213	7,169	2,517
S. Aust. { Ingot & Matte	21,638	13,035	1,869	..	..	..	..	..	..
{ Ore .. ..	..	..	1,880	479	946	457	535	478	4
W. Aust. { Ingot & Matte	..	263	2,661	2,503	737	650	966	1,643	455
{ Ore .. ..	..	..	9,981	8,833	7,901	6,305	5,845	5,559	5,071
Tasmania { Ingot & Matte	..	..	10,029	1,185	66	97	771	444	..
{ Ore .. ..	..	..	..	100	..	..	..	..	..
Northern Territory { Ingot & Matte	..	257	483	424	(a)831	(b)950	(b)48	(b)619	(b)159
{ Ore .. ..	..	..	..	..	..	..	..	..	..

**VALUE.**

	£	£	£	£	£	£	£	£	£
N.S.W...	267,884	119,195	412,202	502,812	598,733	536,127	814,154	696,580	139,296
Victoria	8,186	216	1,994	2,829	..	..	..	..	..
Q'land ..	19,637	4,064	182,256	882,901	1,660,178	2,265,422	2,208,232	2,087,751	952,501
S. Aust.	418,296	235,817	491,617	338,000	488,986	822,527	902,495	828,556	228,930
W. Aust.	..	4,462	110,769	57,091	142,363	64,833	85,738	66,146	10,105
Tasmania	..	..	1,010,037	609,651	375,664	886,454	847,754	776,106	558,694
Nor. Terr.	..	3,619	8,460	7,968	482	(a)3,162	(b)5,517	(b)9,648	(b)2,349
C'wealth	714,003	367,373	2,215,431	2,400,417	3,269,235	4,633,525	4,863,890	4,464,787	1,891,875

(a) 1st January to 30th June. (b) Year ended 30th June.

A short account of the discovery of copper in the different States is given in earlier Year Books.



2. Sources of Production.—(i) *New South Wales.* The principal seat of the copper-mining industry at the present date is in the Cobar district, the value of the deposits there being first recognised in 1869. The value of the output from this district in 1919 was £127,000, out of a total for the State of £139,000. The yield from copper in 1919 was very small as compared with the previous year's total of nearly £697,000, the decline being due to the fall in price of the metal in the early part of 1919, coupled with shipping difficulties and shortage of water. Values of the more important yields furnished during the year were as follows:—Great Cobar Ltd., £69,300; C.S.A., £41,804; Cobar Gladstone, £10,557; Mount Royal Mines, Tottenham, £7,250.

(ii) *Queensland.* The yield in this State amounted in 1919 to 9,997 tons, valued at £952,501, to which the Mount Morgan field contributed 5,332 tons, valued at £506,540. Next in order were Cloncurry with 4,346 tons, valued at £415,653; Gladstone, 175 tons, valued at £16,672; and Herberton, 94 tons, £8,945.

The total production in 1919 was little more than half that of the preceding year, the fall being due to the decline in price of the metal.

The Cloncurry district—reckoned the richest and most extensive cupriferous area in Australia—under normal circumstances produces more than half the copper output of the State, and its yield far exceeds in value the total gold output.

(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 the Commonwealth. 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 will shew. 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, is given in preceding issues of the Official Year Book. During 1919 the output amounted to 2,517 tons, valued at £228,930, the bulk of the production being from the Wallaroo and Moonta Company which in normal times employs over 1,900 hands. Owing to the fall in price of copper during the early months of 1919, and the difficulty in obtaining supplies of fuel, operations were considerably reduced. Recently a discovery of rich ore was made at Dome Rock near Boolcoomatta Station.

(iv) *Western Australia.* The value of copper and ore exported from this State in 1919 was £10,105. According to the returns, the production in the West Pilbara field was 1,031 tons, valued at £15,807, while the Phillips River field shewed a production of 215 tons, valued at £4,993. The Peak Hill and Murchison fields also produced small tonnages.

(v) *Tasmania.* The quantity of copper produced in Tasmania during 1919 was 5,027 tons, valued at £504,961, the bulk of the production being due to the Mount Lyell Mining and Railway Co. Ltd. This Company treated 178,972 tons of ore in 1919, and produced 5,071 tons of blister copper, containing copper, 5,014 tons; silver, 228,652 ozs.; and gold, 5,251 ozs., the whole being valued at £579,768. The employees in 1919 numbered 1,545, of whom 752 were miners, 644 were engaged in the reduction works, and 149 in the railway department.

(vi) *Northern Territory.* Copper has been found at various places, including Copperfield, 5 miles south-east of Pine Creek, Mount Diamond and Burns Wolfram, 45 miles east of Pine Creek, at Coronet Hill, Daly River, Maude Creek, Kilgour Creek, Woolagorang, and Borroloola. The total production in 1919 was 159 tons of ore, valued at £2,349, raised chiefly at Mt. Diamond, Daly River, and Woolagorang.

3. **Prices of Copper.**—The great variation in price that the metal has undergone is shewn in the following table, which gives the average price in London and New York during 1901 and in each of the last five years. The figures are given on the authority of *The Mineral Industry*.

#### FLUCTUATION IN VALUE OF COPPER, 1901 AND 1915 TO 1919.

Year.				London Price per Ton Standard Copper.	New York Price in Cents per lb. Electrolytic Copper.
				£	Cents.
1901	..	..	..	66.79	16.11
1914	..	..	..	61.52	13.60
1915	..	..	..	72.53	17.28
1916	..	..	..	116.03	27.20
1917	..	..	..	124.89	27.18
1918	..	..	..	115.53	24.63
1919	..	..	..	90.80	18.69

4. **World's Production of Copper.**—The world's production of copper in 1901, and during the five years 1915–19, is estimated to have been as follows :—

#### WORLD'S PRODUCTION OF COPPER, 1901 AND 1915 TO 1919.

Year	..	..	..	1901.	1915.	1916.	1917.	1918.	1919.
World's production— (short tons)	..	..	..	583,517	1,206,793	1,552,347	1,582,595	1,537,834	1,085,000

The Australasian production is estimated at about 2 per cent. of the total.

5. **Employment in Copper Mining.**—The number of persons employed in copper mining during 1901 and in each of the last five years was as follows :—

#### PERSONS ENGAGED IN COPPER MINING, 1901 AND 1915 TO 1919.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.	C'wealth.
	No.	No.	No.	No.	No.	No.	No.	No.
1901	2,964	4	814	4,000	321	(a)	(b)	8,103(c)
1915	914	..	2,149	2,000	144	1,758	97	7,062
1916	1,661	..	2,922	2,000	113	1,719	97	8,512
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

(a) Included with silver miners. (b) No returns. (c) Excluding Tasmania and Northern Territory.

## § 6. Tin.

1. **Production of Tin.**—The development of tin mining is, of course, largely dependent on the price realised for the metal, and as in the case of copper, the production has been subjected to somewhat violent fluctuations. The tables below shew the quantity and value of the production as reported to the Mines Departments in each of the Commonwealth States during the years 1881, 1891, 1901, and 1915 to 1919 :—

## TIN PRODUCED IN AUSTRALIA, 1881 TO 1919.

State.	1881.	1891.	1901.	1915.	1916.	1917.	1918.	1919.
--------	-------	-------	-------	-------	-------	-------	-------	-------

## QUANTITY.

		Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
New South Wales	Ingots	5,824	1,454	649	857	909	1,109	1,182
	Ore	609	203	11	1,331	1,220	963	738
Victoria ..	Ingots	70	..	..	..	..	..	..
	Ore	20	1,678	77	96	122	139	135
Queensland	Ingots	479	193	477	(b)	(b)	(b)	(b)
	Ore (a)	2,977	2,043	1,184	2,125	1,707	1,177	1,311
Western Australia	Ingots	..	..	97	..	..	..	..
	Ore	..	204	507	429	463	383	415
Tasmania ..	Ingots	4,120	3,236	1,789	2,103	2,219	2,637	2,256
	Ore	4	56	79	(c)	(c)	(c)	(c)
Northern Territory	Ore	..	29	80	(d) 53	(e) 147	(e) 270	(e) 246

## VALUE.

	£	£	£	£	£	£	£	£
New South Wales	568,795	133,963	76,544	266,780	306,497	373,696	548,876	416,623
Victoria ..	7,620	5,092	4,181	9,447	12,955	19,709	24,481	17,561
Queensland ..	193,699	116,387	93,723	183,472	181,401	160,600	251,755	143,167
Western Australia	..	10,200	52,102	41,391	49,101	45,288	76,952	47,269
Tasmania ..	375,775	292,990	216,186	292,306	350,852	427,917	488,798	395,794
Northern Territory	..	1,870	5,498	(d) 5,545	(e) 14,700	(e) 27,120	(e) 41,432	(e) 30,021
Total	1,145,889	560,502	448,234	798,941	915,506	1,054,330	1,432,294	1,050,435

(a) Dressed tin ore, about 70 % tin. (b) Included with ore. (c) Included with ingots.  
(d) 1st January to 30th June. (e) Year ending 30th June.

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 1919 being valued at £174,013. In the Tingha division of the Peel and Uralla district the yield amounted to 627 tons, valued at £99,058. The Emmaville division in the new England district shewed a yield of 995 tons, valued at £166,754, the Vegetable Creek mine in this area being the chief producer of tin in the State with an output in 1919 of 360 tons, valued at £58,880. In the Wilson's Downfall division, 156 tons, valued at £24,182, were raised. The Glen Innes division, also in the New England district, returned a yield of 161 tons, valued at £25,325, and the Torrington division 95 tons, valued at £18,300. The Ardlethan field, in the Lachlan division, produced ore and concentrates to the value of £66,009.

(ii) *Victoria.* In Victoria lode tin has been discovered at Mt. Wills, Beechworth, Eldorado, Chiltern, Stanley, and other places in the north-eastern district; and stream tin has been found in a large number of places, including those just mentioned in the north-eastern district. The bulk of the production in 1919 was obtained by dredging and sluicing, the Cock's Pioneer Gold and Tin Co. in the Eldorado district contributing 98 tons, valued at £15,162. Small quantities were also won in the Beechworth District, and at Mount Cudgewa and Walwa.

(iii) *Queensland.* The chief producing districts in Queensland during 1919 were Herberton, 525 tons, valued at £71,994; Stanthorpe, 118 tons, £18,007; Cooktown, 127 tons, £19,329; Chillagoe, 124 tons, £16,353; and Kangaroo Hills, 92 tons, £16,299. The production of tin was adversely affected in 1919 by the prolonged dry weather, and also by a shortage of explosives during the latter half of the year.

(iv) *Western Australia.* The export of tin ore for the State during 1919 amounted to 318 tons, valued at £47,269. The production from the Greenbushes field amounted to 245 tons, valued at £34,959, and from the Pilbara field 37 tons, valued at £5,871. There was no production from the other fields in 1919.

(v) *Tasmania.* During 1919 the quantity of metallic tin won amounted to 1,580 tons, valued at £395,794. The bulk of the production in 1919 came from the North-Eastern Division with 679 tons, valued at £174,319. Of the total yield in this division, 324 tons were contributed by the Pioneer and Gladstone districts, 272 tons by the Ringarooma, Derby, and Branzholm districts, and small quantities from Moorina district and Straits Islands. The next highest output was returned from the North-Western division with 516 tons, to which the celebrated Mt. Bischoff contributed 351 tons, and the Mt. Bischoff Extended, 146 tons. In the Eastern division, the Avoca mines produced about 75 tons out of a total of 223 tons. The mines in the Western division produced 123 tons of metallic tin in 1919.

(vi) *Northern Territory.* The yield of tin ore in 1919 amounted to 162 tons, valued at £30,021, of which the Marranboy field contributed 75 tons, valued at £15,000, and Mt. Wells about 23 tons, valued at £3,700. Small yields were returned also from Crest of Wave, Horseshoe Creek, Hayes Creek, Umbrawarra, and other districts. Two batteries for the treatment of tin ore have been erected by the Government, one at Marranboy, costing £20,163, and one at Hayes Creek, at an expense of £3,294.

3. *World's Production of Tin.*—According to *The Mineral Industry* the world's production of tin during each of the last five years was as follows :—

#### WORLD'S TIN PRODUCTION, 1915 TO 1919.

1915.	1916.	1917.	1918.	1919.
Tons. 113,319	Tons. 114,108	Tons. 124,283	Tons. 121,524	Tons. 113,893

The yields from the chief producing countries in each of the last three years were as follows :—

	1917.	1918.	1919.
Malaya ..	39,800 ..	37,300 ..	36,900 ..
Bolivia ..	27,800 ..	29,300 ..	27,500 ..
Banka ..	13,200 ..	13,200 ..	11,600 ..
Siam ..	8,800 ..	9,100 ..	8,800 ..
Cornwall ..	3,900 ..	4,000 (a) ..	3,300 (a) ..
Billiton ..	5,500 (a) ..	6,900 (a) ..	6,900 (a) ..
Nigeria ..	6,500 ..	6,000 (a) ..	5,000 (a) ..
China ..	11,000 (b) ..	8,700 (b) ..	8,000 (b) ..
Australia ..	4,000 (a) ..	4,300 (a) ..	4,000 (a) ..
South Africa ..	1,600 ..	1,200 ..	1,000 ..
India ..	1,200 ..	1,000 (a) ..	500 (a) ..

(a) Estimate. (According to returns furnished by the Australian Metal Exchange the figures for Australia for the three years were 4,000, 4,600, and 4,100 tons respectively.) (b) Shipments to Europe and U.S.A.

Based on the results for the last three years, Australia's share of the world's tin production would appear to be about  $3\frac{1}{2}$  per cent.

4. **Prices of Tin.**—The average price of the metal in the London market for the years 1897 and 1907 and from 1910 to 1919 was as follows:—

**PRICE PER TON OF TIN, 1897 TO 1919.**

Year.			Price per Ton.	Year.			Price per Ton.
			£ s. d.				£ s. d.
1897	..	..	61 8 0	1914	..	..	156 12 7(a)
1907	..	..	172 12 9	1915	..	..	164 4 0
1910	..	..	155 6 2	1916	..	..	182 3 5
1911	..	..	192 7 0	1917	..	..	237 13 1
1912	..	..	209 8 5	1918	..	..	329 11 2
1913	..	..	206 5 7	1919	..	..	257 9 8

(a) Quotations incomplete.

According to *The Mineral Industry* the monthly average in December, 1917, reached £298 10s. 3d. per ton. Conditions in 1917 were, however, quite abnormal, and, instead of London prices ruling the market, each consuming country tended to fix its own rates, with the result that widely different quotations were recorded from London, New York, France, and Italy. Owing to various causes such as shortage of labour, plant, and supplies, increases in wages, difficulty of obtaining information as to the relative position in the producing centres, interference with the ordinary course of trade, &c., prices in 1918 mounted to phenomenal heights. Quotations in January averaged £293 6s. 1d. per ton and increased rapidly until May when the price reached £364 7s. 8d. A falling-off in the next two months was succeeded by a rise to the sensational figure of £380 16s. 8d. in August. Thenceforward a sharp decline was experienced, and for the closing month of the year the average was recorded as £267 14s. 3d. In January, 1919, the average price was given as £248 9s. 11d., but the market fell in the succeeding months until July, when there was a rise to £253 5s. 1d. An upward tendency was manifested in the latter months of the year, the average for December being £314 5s. 1d.

5. **Employment in Tin Mining.**—The number of persons employed in tin mining in 1901 and during the last five years is shewn below:—

**PERSONS ENGAGED IN TIN MINING, COMMONWEALTH, 1901 AND 1915 TO 1919.**

Year.			N.S.W.	Victoria.	Qld.	W. Aust.	Tas.	Nor. Ter.	C'wealth
			No.	No.	No.	No.	No.	No.	No.
1901	..	..	1,428	..	1,148	413	1,065	..	4,054
1915	..	..	1,648	27	1,218	188	1,221	154	4,456
1916	..	..	1,938	135	1,093	235	1,217	154	4,772
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

**§ 7. Zinc.**

1. **Production of Zinc.**—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

cannot be credited 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.

#### NEW SOUTH WALES.—EXPORTS OF ZINC CONCENTRATES, ETC., 1889 TO 1919.

Year.	Quantity of Zinc Concentrates, &c., Exported.	Value.	Year.	Quantity of Zinc Concentrates, &c., Exported.	Value.
	Tons.	£		Tons.	£
1889	97	988	1916	209,741	961,849
1891	219	2,622	1917	113,531	441,486
1899	49,879	49,207	1918	87,019	295,413
1915	190,916	1,111,569	1919	72,294	247,395

A statement of the quantity of zinc locally extracted, and the estimated zinc contents of concentrates exported or sold for export during the five years 1916–20, will be found in § 17 hereinafter.

At the Silver Spur mine at Texas, in the Stanthorpe division in 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 in the years 1917 to 1919.

The Tasmanian mineral returns for 1919 included an item of 285 tons of zinc ore, valued at £13,110, raised at the Read Rosebery Mine.

Investigations in regard to the Read-Rosebery 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.

2. Prices of Zinc.—During the four years 1911 to 1914, the 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., and for 1919, £42 17s. 7d. per ton.

### § 8. Iron.

1. General.—The fact that iron-ore is widely distributed in the Commonwealth 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 until quite recently, little has been done in the way of converting these deposits into a marketable commodity.

(i) *The Manufactures Encouragement Act 1908–14.* It was hoped that the passing by the Commonwealth Parliament of the Manufactures Encouragement Act, which came into force on the 1st January, 1909, would assist in firmly establishing the iron industry in Australia on a remunerative basis, both in the smelting of pig iron and in the production of bar iron and steel from Australian ore. The Act referred to, together with its amendment in 1912, provided for the payment up to June, 1914, of bounties of 12s. per ton on Australian pig iron, puddled bar iron, and steel, and of 10 per cent. on the value of galvanised sheet or plate, wire netting, wire, and iron or steel pipes and tubes. During the period from 30th June, 1909, to 30th June, 1915, a sum of £173,671 was paid in connexion with these bounties. (For details see Official Year Book No. 11, p. 452.)

(ii) *The Iron Bounty Act 1914–15.* This Act repealed the Manufactures Encouragement Act 1908–14, and provided for a bounty on Australian pig iron up to the end of 1916. The rate of bounty was 8s. per ton, and the total amount authorised £60,000. Provision was made for transfer, if required, to the State, of lands, buildings, etc., used

in the manufacture of pig iron. During the three years 1915 to 1917 the respective bounties amounted to £19,808, £24,465, and £11,454, and the corresponding tonnages of pig iron to 49,520, 61,162, and 28,635 tons. New South Wales is the only State where bounty has been claimed.

2. *Production of Iron.*—(i) *New South Wales.* Reference to the extent of the deposits of iron ore in the State, and the events leading up to the establishment of iron-works at Lithgow, will be found in earlier issues of the Year Book (see No. 3., p. 508). During 1919 the following materials were received at the blast furnace at the Eskbank Iron Works, Lithgow:—Iron ore, 141,926 tons; limestone, 60,004 tons; and coke, 119,895 tons. The iron ore was raised from quarries at Tallawang, Breadalbane, Cadia, and Carcoar, and the output was 80,941 tons of pig iron.

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

NEW SOUTH WALES.—PRODUCTION OF IRON (LOCAL ORE), 1913 TO 1919.

Particulars.	1913.	1914.	1915.	1916.	1917.	1918.	1919.
Quantity .. Tons	46,563	75,150	76,318	52,556	45,025	68,072	80,941
Value .. £	186,252	254,257	267,000	197,085	247,637	350,000	445,175

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 shewn 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.

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 utilising 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, 1920, amounted to 413,150 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 steel works consist of two blast furnaces of a nominal daily producing capacity of 350 tons each, and a third furnace of 100 tons for the production of foundry iron. Another furnace with a capacity of 350 tons is in course of erection, and should be in operation during the latter part of 1921. The output of pig iron for the year from the two blast furnaces and small foundry furnace, which is now used extensively for the production of ferro-manganese, amounted to 251,416 tons. The seven 65-ton open-hearth steel furnaces already in operation are being extended by the addition of two others of equal capacity. With seven furnaces, the present output is over 3,400 tons weekly. The actual output of steel ingots during 1920 was 219,973 tons. The works are supplied with a 28-in. bloom and rail-rolling mill, able to deal with 500 tons of finished rails daily. There are also in operation an 18-in., 12-in., and 8-in. mill for merchant steel, as well as a rod mill for production of rods for wire drawing capable of an output of 350 to 400 tons of rods per week down to size No. 5 (.212 of an inch). The output from the mills during the twelve months ending 1920 was as follows:—

Rails .. ..	54,170 tons
Billets .. ..	8,723 „
Fishplates and Splice Bars ..	4,711 „
Structural Steel .. ..	19,502 „
Round and Octagon Steel ..	19,070 „
Flat Steel .. ..	16,826 „
Plates .. ..	2,092 „
Square Steel .. ..	1,065 „
Rods .. ..	49,814 „
<b>Total .. ..</b>	<b>175,973 tons</b>

The Company is producing its own coke for the furnaces, having already 161 by-products ovens in operation and 63 in course of construction. The tar and sulphate of ammonia produced during 1920 amounted to 2,710,472 gallons and 3,589 tons respectively.

A quantity of iron oxide is purchased by the various gasworks for use in purifying gas, the output in New South Wales being drawn chiefly from the deposits at Port Macquarie, while smaller quantities are obtained in the Moss Vale and Goulburn Divisions. During 1919 the iron oxide raised amounted to 2,724 tons, valued at £3,406. Up to the end of 1912 a certain amount of ironstone was raised each year for fluxing purposes, but as the smelting companies obtained suitable ores for treatment there was no subsequent production till 1916, when 1,472 tons, valued at £1,083, were raised. In 1919 the quantity raised was 2,128 tons, valued at £2,072.

(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 states 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 1919, 24,676 tons of ironstone flux, valued at £27,684, were raised, of which 23,200 tons, valued at £26,669, came from the Rockhampton district, and about 1,300 tons, valued at £900, from the Cloncurry field. In 1917 satisfactory tests were made in connexion with the smelting of ore from the extensive lode of magnetic iron at Biggenden, and the Government Geologist has recommended the establishment of a State ironworks to make pig iron from this ore.

(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 utilises ore from this quarry at its ironworks at Newcastle, New South Wales, and the amount raised for the year 1919 was 268,530 tons, valued at £307,402.

(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 Murchison field possesses some extensive deposits of high-grade ore. There are also deposits on Koolan Island at Yampi Sound. The production of pyritic ore reported in 1919 amounted to 4,136 tons, valued at £4,919.

(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
<b>Total .. .. .</b>	<b>41,900,000</b>

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 1919 being 3,457 tons, valued at £4,288.

(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.



(viii) *World's Production of Iron, 1917.* The quantity of iron produced in Australia is but a very small proportion of the world's production, which in 1917, the latest year for which complete estimates are available, amounted to 72,382,000 metric tons (pig iron). The leading position for magnitude of production is held by the United States, which in 1917 produced 39,240,000 tons, compared with Germany's 13,142,000 tons, and the United Kingdom's 9,572,000 tons. The position of the three countries named is similar to what it has been for several years past. The world's production of steel for 1917 is given as 84,894,000 metric tons.

## § 9. Other Metallic Minerals.

1. **Antimony.**—This metal is widely distributed in the north-eastern portion of New South Wales, between the 148th meridian and the coast, and has been found native at Lucknow, near Orange. Dyscrasite, a silver antimonide, has been found in massive blocks in the Broken Hill lodes. The production of antimony (metal) in 1919 amounted to 87 tons, valued at £2,342. The ore is raised mainly in the Hillgrove division, where it is found in association with scheelite and gold, and the production in 1919 amounted to 161 tons, valued at £2,317. A portion of this was smelted on the field. A small quantity of stibnite, valued at £25, was produced at Burropine in the Kempsey division. Owing to the low price of the metal in 1919 there was no work done on the large deposits in the Drake division. The total quantity of antimony (metal and ore) raised in New South Wales up to the end of 1919 was 18,707 tons, valued at £341,183. The production of antimony concentrates in Victoria during 1919 amounted to 1,208 tons, valued at £24,160. 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. Owing to the low price of the metal in 1919 production was practically negligible. 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 production in 1918 and 1919.

2. **Arsenic.**—In New South Wales, deposits of arsenical ore have been located at various places, but production in 1919 was small, amounting to 6 tons, valued at £24, raised at Burrowa. Prospecting was in progress on a rich deposit at Brungle, and deposits were tested at Tyagong in the Young division, and at Rockdale near Armidale. During 1917 the high price ruling for arsenic, and the urgency of the need for supplies in connection with the destruction of prickly pear, led to the reservation by the Queensland Mines Department of an extensive area of arsenic-bearing deposits at Jibbinbar, in the Stanthorpe district. Operations have been commenced, and it is hoped to produce the article at pre-war prices. At the Beecroft mine at Sundown, in the Stanthorpe district, 23 tons were produced in 1919, while the State mine at Jibbinbar during the portion of the year when it was in operation returned an output of 33 tons. In South Australia attention is being devoted to arsenic-bearing minerals at Woodside, at Westward Ho, near Mannahill, and on Kangaroo Island. During 1918 Western Australia exported 697 tons of arsenical ore, valued at £2,564, but there was no production in 1919. In the form of arsenopyrite, arsenic is of wide distribution in Victoria, but the deposits are worked to a limited extent only. At Ballarat a small quantity of the oxide is obtained from the flues of roasting furnaces.

3. **Bismuth.**—This metal has been found in New South Wales, near Glen Innes, in the Deepwater division, and also at Whipstick, in the Pambula division, its discovery dating from 1877. The production at Kingsgate, in the former division, where bismuth occurs in association with molybdenite, was valued in 1919 at £3,914, while that at Whipstick was valued at £1,263. Deposits of bismuth ores are also found in the Oberon, Deepwater, Tenterfield, Young, and Gundaroo divisions. About 19 tons of metal and ore, valued at £20,215, were exported from New South Wales during 1919; the total quantity exported to the end of that year was 684 tons, valued at £189,042. In Queensland wolfram and bismuth have been found in various districts, but the chief

centres of production in 1919 were the Herberton and Chillagoe fields. The total production for the year was valued at £59,932, of which 229 tons, valued at £40,596, was returned as wolfram, 20 tons, valued at £655, as bismuth, and 140 tons, valued at £18,681, as bismuth and wolfram. 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. In Tasmania 2 tons, valued at £573, were raised in 1919, principally from the Shepherd and Murphy mine at Middlesex.

4. **Chromium.**—In New South Wales chromium is found at Bowling Alley Point, on the Peel River, at Barraba, at Manilla, at Gordon Brook, in the Clarence River district, at Bingara, Wallendbeen, and near Gundagai. The production during recent years has been small, the quantity raised in 1919 being 250 tons, valued at £616, of which 150 tons, valued at £340, were obtained in the Bingara division, and smaller quantities were raised at Cullinga and Braulin in the Cootamundra division. Chrome iron ore is found in Queensland in the Rockhampton district, but there was no production recorded in 1919.

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. Deposits have been noted in Queensland at Selwyn in the Cloncurry area; in South Australia near Bimbourie and South Blinman; in Western Australia at Norseman and Kanowna; and at various places in Victoria.

6. **Lead.**—This metal was first noted in New South Wales in 1849, when small specimens of native metal were found by the Rev. W. B. Clarke. At present lead mining *per se* is not practised to any extent in the Commonwealth, the supply of the metal being chiefly obtained in conjunction with silver. In New South Wales, lead in the form of pig, carbonate, and chloride, exported in 1919, amounted to 11,497 tons, valued at £324,215. The total lead exported to the end of 1919 was 298,000 tons, valued at £5,775,000. 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 1919 amounting to 135 tons, valued at £4,739. At one time South Australia produced a fair amount of lead, £22,303 worth being raised in 1902, but the production rapidly decreased, and no output has been recorded since 1910. During 1919 pig lead exports from Western Australia amounted to 1,780 tons, valued at £48,462. Tasmanian lead production in 1919 was returned as 2,357 tons, valued at £64,403, of which the Zeehan mines contributed 808 tons, the Mt. Farrell mines, 447 tons, Magnet, 529 tons, and Mt. Claude mines, 365 tons.

7. **Manganese.**—Ores of this metal occur in widely separated districts in New South Wales, but the low price of the metal in past years precluded mining to any great extent, and the production to date has been small. During 1919, 4,651 tons, valued at £13,953, were raised chiefly in the Grenfell division. Small quantities were also raised in the Parkes, Rockley, Rathurst, Tamworth, Uralla, Bingara, Cootamundra, Fifield, and Cooma divisions. Manganiferous deposits were recorded in the Armidale and Molong divisions. In Queensland there are extensive deposits at Mount Miller, near Gladstone, in the country to the west and south-west of Gympie, and in the Stanthorpe district. Owing to lack of a market, production in 1919 was limited to 20 tons, valued at £103. Small quantities of manganese ore were raised in Victoria during 1916 from mines in the vicinity of Heathcote. 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 1919 was valued at £1,490. In Western Australia ores of the metal are found widely scattered, the black oxide being especially plentiful in the Kimberley district.

8. **Mercury.**—In New South Wales mercury was first recorded by the Rev. W. B. Clarke in 1841. Cinnabar has been found in lodes and impregnations at various places, such as Bingara, Clarence River, etc. Up to the present the production of quicksilver

has been small, the total being only about 3,000 lbs. During 1916 the Pulganbar Company raised 200 tons of ore from their mine at Engwar in the Drake division. The mercury produced was valued at £180. There was no production recorded in the years 1917 to 1919. In Victoria native mercury and cinnabar have been found at Silver Creek, a tributary of the Jamieson River. Lodes of cinnabar have been found in Queensland at Kilkivan, and at Black Snake, in the Wide Bay district; about four tons were produced between 1874 and 1891. Between O.K. and Mungana several shows have been prospected with encouraging results. Small quantities have been found disseminated over a large area near Willunga in South Australia, and the metal is also found in New Guinea.

9. **Molybdenum.**—In New South Wales molybdenite (associated with bismuth) is obtained at Kingsgate, near Glen Innes, at Deepwater, at Rocky River in the Tenterfield division, in the Bathurst division, and at Whipstick in the Pambula division, the production in 1919 being 66 tons, valued at £30,308, as compared with 93 tons, valued at £41,850 in the previous year. In Victoria 78 tons of molybdenite, valued at £2,531, were raised in 1919 at Everton. The production in Queensland for 1919 was 118 tons, valued at £52,234, of which 73 tons, valued at £33,088, were produced by the Chillagoe field, and 43 tons, valued at £18,540, from the Mount Perry area. 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, and the molybdenite is picked out during the dressing of the copper ore. The yields for the last three years were, however, trifling. Molybdenite occurs in small quantities at various localities in Western Australia, the production in 1919 being valued at £100. In the Northern Territory, molybdenite is found at Yenberrie, where it is stated that the ore increases in richness as the workings become deeper. Production in 1919 was, however, very small.

10. **Radium.**—(i) *General.* It is reported that there have been several definite discoveries in Australia of the occurrence of minerals containing radium. A discovery of carnotite, which is an alteration product of pitchblende, the compound from which radium is obtained, was made in 1906, 20 miles E.S.E. of the Olary railway station, in South Australia. In 1910 pitchblende was identified in portion of the workings at Olary, and a specimen exhibiting a high degree of radio-activity was obtained. This is the first authentic discovery of the mineral pitchblende in Australia. The deposits of radio-active uranium ores found at Radium Hill were mined some years ago, and the concentrates forwarded to Sydney for treatment at the company's works at Woolwich. As noted in (ii) below, operations are at present at a standstill. Monazite from Pilbara, Western Australia, has been shewn to give off radium emanations. The mineral has been called "pilbarite." Lastly, it is stated that the ores obtained at the Moonta mines, South Australia, contain from one-tenth to one-fifteenth of the amount of radium found in high-grade pitchblende, and that a product having a fairly high degree of radio-activity can be extracted therefrom with comparative ease. During 1918 radio-active ore to the value of £686 was raised in South Australia, but there was no production recorded in 1919.

(ii) *Production of Radium Bromide.* At the end of November, 1912, a small quantity of radium bromide was produced at the Radium Hill Co.'s works at Woolwich, Sydney, this being the first occasion on which a marketable amount of this salt has been obtained outside of Europe. It was estimated by the chemist in charge that the plant at the works was capable of providing £600 worth of radium weekly. From the 30th June, 1913, to the end of May, 1914, the works produced 239 milligrams of high-grade radium preparation. The industry, however, has since remained inactive.

11. **Tungsten.**—Wolfram and scheelite, the principal ores of tungsten, are both mined to some extent in New South Wales. During 1919 the production of wolfram was 135 tons, valued at £22,818, and of scheelite 80 tons, valued at £15,193. Wolfram was mined chiefly in the Torrington division of the New England District, and scheelite in the Hillgrove area. In Victoria the production of wolfram was returned in 1919 as 2½ tons, valued at £400, the bulk of the production coming from Thologolong, Marysville, and Barrakee. In Queensland, tungsten ores are found in several districts, the chief centres of production in 1919 being Chillagoe and Herberton. (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. In the Northern Territory wolfram

to the value of £34,805 was obtained in 1918-19, chiefly from Hatches Creek Wauchope Creek and Yenberrie. Numerous samples of good wolfram ore have been obtained at the Frew River in Central Australia.

In Western Australia, in addition to a small quantity of wolfram, 6 tons of scheelite, valued at £772, were exported in 1919. Wolfram is mined at various points in Tasmania, the production for 1919 being 121 tons, valued at £26,613, obtained chiefly at the Avoca mines, and from the Shepherd and Murphy mine at Middlesex. Scheelite has been discovered on King Island in Bass Strait, and as a result of operations 199 tons of concentrates of an estimated value of £43,181 were produced in 1919.

12. **Tantalum.**—Tantalite in small quantities has been found in the Greenbushes mineral field of Western Australia for some time past, but recently a lode of fairly extensive proportions was located at the Wodgina tinfield. Up to the end of 1905 the production of this mineral in Western Australia amounted to 73 tons, valued at about £10,000, but early in 1906 it was found that the supply exceeded the demand, and production was temporarily stopped; in 1908 a small quantity valued at £400 was exported. About £327 worth was reported as having been raised in the Greenbushes and Pilbara fields during 1909, but none was exported owing to the entire absence of any market. No further production was recorded until 1916, when 47 tons, valued at £9,375, were exported, consisting of ore which had been raised some years previously at Wodgina, in the Pilbara field. The export in 1917 amounted to 17 tons, valued at £2,513, but there was no record of production in 1918, while the export in 1919 was valued at £75. Small quantities of the mineral are also found in the Northern Territory.

13. **Uranium.**—This mineral has been discovered in South Australia in the country between Mount Painter and Mount Pitts, about 80 miles east from Farina. The uranium ores occur most frequently in the form of torbernite and autunite, and are found over a considerable area. The discovery is therefore of considerable importance, since ores of this mineral are found to a very limited extent in other parts of the world, and radium is regarded as one of the products of disintegration of uranium.

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.

## (B) NON-METALLIC MINERALS.

### § 10. Coal.

1. **Production in each State.**—(i) *Historical.* 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.)

(ii) *New South Wales.* The production in 1919 amounted to 8,631,554 tons, valued at £5,422,846, or a decrease of about 432,000 tons in quantity, but an increase of £481,000 in value, as compared with the output in 1918. From the collieries in the Northern district the output in 1919 was 5,629,703 tons; the Southern district supplied 1,826,574 tons; and the Western 1,175,727 tons. The quantities raised in each district in 1918 were 5,966,926, 1,984,578, and 1,111,672 tons respectively. The reduced output in the Northern and Southern districts was partly accounted for by lack of shipping facilities, through strikes, and partly by stoppages at several collieries due to industrial disputes. The increased yield in the Western district was mainly due to the fact that supplies of coal were sent by rail from Lithgow to Victoria during the period when sea carriage had ceased.

(iii) *Victoria.* During 1919 the production amounted to 423,945 tons of black coal, valued at £372,075, and 111,628 tons of brown coal, valued at £34,542. Of the total output, 361,872 tons, valued at £307,591, were raised by the State coal mine at Wonthaggi, and 110,183 tons, valued at £34,253, from the State brown coal mine at Morwell. The total production for 1919 was about 30,000 tons in excess of that in the preceding year.

(iv) *Queensland.* The quantity of coal raised in 1919 was 931,631 tons, valued at £614,307, this production being about 52,000 tons less than in the preceding year. The decrease was due to the lessened production in the Ipswich district. Twenty-six collieries were working in the Ipswich district, six on the Darling Downs, five in the Maryborough district, four in Rockhampton district, five at Clermont, one at Bowen, and one at Mount

Mulligan in the Chillagoe district. The industry is at present in a very satisfactory position in the northern State, and owing to the wide area over which the deposits stretch, practically no limit can be set to its possibilities of extension.

(v) *Western Australia.* Six collieries were in operation on the Collie field during 1919, and the output for the year was 401,713 tons, the largest on record, and about 65,000 tons more than in 1918.

(vi) *Tasmania.* The principal collieries in Tasmania are the Cornwall and Mount Nicholas, the former producing 31,000 and the latter 28,000 tons out of a total yield in 1919 of 66,000 tons.

The quantity and value of coal produced in each State and in the Commonwealth at various periods since 1881 are shewn in the following table :—

#### PRODUCTION OF COAL, AUSTRALIA, 1881 TO 1919.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tasmania.	C'wealth.
QUANTITY.							
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1881 .. ..	1,769,597	3	65,612	..	..	11,163	1,846,875
1891 .. ..	4,037,929	29,156	271,603	..	..	43,256	4,381,944
1901 .. ..	5,968,426	209,479	539,472	..	117,836	45,438	6,880,651
1915 .. ..	9,449,008	590,968	1,024,273	..	286,666	64,536	11,415,451
1916 .. ..	8,127,161	420,098	907,727	..	301,528	55,575	9,812,087
1917 .. ..	8,292,867	505,364	1,048,473	..	326,550	63,412	10,236,666
1918 .. ..	9,063,176	505,775	983,193	..	337,039	60,163	10,949,346
1919 .. ..	8,631,554	535,573	931,631	..	401,713	66,253	10,566,724
VALUE.							
	£	£	£	£	£	£	£
1881 .. ..	603,248	3	29,033	..	..	5,581	637,865
1891 .. ..	1,742,796	21,404	128,198	..	..	21,628	1,914,026
1901 .. ..	2,178,929	147,228	189,877	..	68,561	18,175	2,602,770
1915 .. ..	3,424,630	275,343	409,342	..	137,859	30,418	4,277,592
1916 .. ..	3,336,419	216,875	389,348	..	147,823	27,736	4,118,201
1917 .. ..	4,422,740	345,830	597,360	..	191,822	38,673	5,596,425
1918 .. ..	4,941,807	367,640	572,305	..	204,319	37,676	6,123,747
1919 .. ..	5,422,846	406,617	614,307	..	270,355	47,004	6,761,129

The Victorian figures for 1919 include about 112,000 tons of brown coal, valued at £35,000, of which over 110,000 tons were produced at the State mine at Morwell.

2. *Distribution and Quantity of Coal in each State.*—(i) *New South Wales.* Estimates have from time to time been made as to the total quantity of coal available for working in the deposits in New South Wales, and while these naturally differ to some extent, they agree in placing the amount at well over a thousand million tons, without taking into consideration the deposits existing below a depth of 4,000 feet. 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. 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, some of which has realised good prices as fuel.

The table hereunder gives the yields from the various divisions at intervals from 1881 to 1919:—

#### COAL RAISED IN NEW SOUTH WALES, 1881 TO 1919.

District.	1881.		1901.		1911.		1919.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	£	Tons.	£	Tons.	£	Tons.	£
Northern..	1,352,472	437,270	3,999,252	1,669,519	5,793,646	2,320,673	5,829,253	3,785,244
Southern..	253,283	115,505	1,544,454	407,196	2,066,621	636,163	1,826,574	1,078,003
Western ..	163,842	50,473	424,720	102,214	831,337	210,329	1,175,727	549,599
Total ..	1,769,597	603,248	5,968,426	2,178,929	8,691,604	3,167,165	8,631,554	5,422,846

*Sydney Harbour Colliery.* This colliery possesses considerable interest from the circumstance that its workings are amongst the deepest in the world. Extended reference to the history of its opening will be found in preceding Year Books. (See No. 6, p. 504.)

(ii) *Victoria.* 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. 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 for 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 output of coal from the chief Victorian collieries during the last ten years was as follows:—

### PRODUCTION OF COAL IN VICTORIA, 1910 TO 1919.

Year.	State Coal Mine.	Outtrim Howitt Company.	Jumbunna Coal Company.	Coal Creek.	Austral Coal.	Other.	Total Pro- duction.	Value.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	£
1910 ..	201,053	46,832	61,954	10,968	36,052	13,050	369,909	189,254
1911 ..	506,059	28,359	57,397	4,589	34,607	23,987	659,998	301,141
1912 ..	455,659	24,326	53,306	4,829	31,506	23,529	593,155	259,321
1913 ..	486,238	22,460	38,795	6,218	33,462	9,723	596,896	274,940
1914 ..	550,107	16,597	24,236	5,887	20,034	3,390	620,251	289,099
1915 ..	528,922	7,500	28,160	6,338	16,229	3,819	590,968	275,343
1916 ..	354,146	..	31,792	5,688	10,885	17,587	420,098	216,875
1917 ..	405,498	..	22,236	1,958	13,888	61,784	505,364	345,830
1918 ..	389,794	..	16,533	2,378	15,419	81,651	505,775	367,640
1919 ..	361,871	..	21,716	1,465	11,824	138,697	535,573	406,617

Included in the total for "other" is an amount of 22,335 tons raised by the Powlett North Woolamai, and 4,734 tons raised by the Sunbeam Colliery. The figures also include 110,183 tons of brown coal raised by the State mine at Morwell, and 1,445 tons raised by the Altona Beach Estates.

(iii) *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.

(iv) *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 Broomsound 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 quantity and value of coal raised in Queensland at various periods since 1861 were as shewn below:—

### PRODUCTION OF COAL IN QUEENSLAND, 1861 TO 1919.

Year .. .. .	1861.	1871.	1881.	1891.	1901.	1919.
Quantity .. Tons	14,212	17,000	65,612	271,603	539,472	931,631
Value.. .. £	9,922	9,407	29,033	128,198	189,877	614,307

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

### QUEENSLAND COLLIERIES, 1917, 1918, AND 1919.

Districts.	1917.	1918.	1919.
	Tons Raised.	Tons Raised.	Tons Raised.
Ipswich .. .. .	728,605	678,931	620,608
Darling Downs .. .. .	97,797	94,242	97,454
Wide Bay and Maryborough .. .. .	72,282	62,948	63,665
Rockhampton (central) .. .. .	6,410	7,955	8,350
Clermont .. .. .	132,664	122,812	121,250
Bowen (State Coal Mine) .. .. .	..	..	306
Mount Mulligan (Chillagoe) .. .. .	10,715	16,305	19,998
Total .. .. .	1,048,473	983,193	931,631

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 brought from Newcastle.

(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. About 271,000 tons of the total production in 1919 was taken by the railways and tramways, the balance being sold for bunkering and local trade. The production from this field since 1901 was as follows :—

### PRODUCTION OF COAL IN WESTERN AUSTRALIA, 1901 TO 1919.

Year ..	1901.	1911.	1914.	1915.	1916.	1917.	1918.	1919.
Quantity Tons	117,836	249,899	319,210	286,666	301,526	326,550	337,039	401,713
Value £	68,561	111,154	148,684	137,859	147,823	191,822	204,319	270,355

In 1918 a discovery of coal was made near Wilga on the Donnybrook-Katanning railway.

(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, Langlosh, 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.

#### PRODUCTION OF COAL IN TASMANIA, 1901 TO 1919.

District.	1901.	1911.	1914.	1915.	1916.	1917.	1918.	1919.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
North-western ..	2,952	1,496	1,074	270	673	350	1,353	2,836
North-eastern ..	37,239	54,296	58,743	63,507	54,284	61,910	56,461	59,509
Midland ..	1,536	635	847	691	598	399	1,161	2,899
South-eastern ..	..	640	130	68	20	753	1,188	1,009
South-western ..	3,711							
Total ..	45,438	57,067	60,794	64,536	55,575	63,412	60,163	66,253

The bulk of the output in 1919 was raised from the Cornwall and Mt. Nicholas mines in the North-eastern Division, which produced 31,456 and 28,053 tons respectively.

3. *Production of Coal in Various Countries.*—The total known coal production of the world in 1919 amounted to about 1,100 million tons towards which the Commonwealth contributed  $10\frac{1}{2}$  million tons, or about 1 per cent. The following table shews the production of the British Empire and the chief foreign countries in units of 1,000 tons in 1901 and during each of the years from 1912 to 1919 where the returns are available :—

#### COAL PRODUCTION, BRITISH EMPIRE, 1901 AND 1912 TO 1919.

Year.	United Kingdom.	British India.	Canada.	Australian C'wealth.	New Zealand.	Union of S. Africa.
	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.
1901 ..	219,047	6,636	5,791	6,881	1,228	712
1912 ..	260,416	14,706	15,237	11,730	2,178	7,248
1913 ..	287,430	14,708	13,404	12,418	1,888	7,858
1914 ..	265,665	16,446	12,176	12,445	2,276	7,570
1915 ..	253,206	17,104	11,846	11,415	2,209	7,394
1916 ..	256,375	17,254	12,931	9,812	2,257	8,935
1917 ..	248,499	17,326	12,543	10,237	2,068	9,270
1918 ..	227,749	19,847	13,377	10,949	2,034	8,819
1919 ..	209,860	..	12,130	10,567	1,849	9,166

#### COAL PRODUCTION, FOREIGN COUNTRIES, 1901 AND 1911 TO 1919.

Year.	Russia.	Sweden.	Germany.	Belgium.	France.	Spain.	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.
1901 ..	18,215	268	106,795	21,856	31,126	2,609	8,885	240,789
1912 ..	30,796	354	174,261	22,972	40,487	3,790	19,640	477,202
1913 ..	33,299	358	188,447	22,474	39,410	3,952	21,377	508,893
1914 ..	32,620	361	158,950	16,445	26,412	4,067	22,385	458,504
1915 ..	27,847	405	144,365	13,949	18,554	4,289	20,570	474,660
1916 ..	47,075	408	156,305	16,592	20,213	5,033	23,082	526,873
1917 ..	..	436	164,634	14,692	27,313	5,281	26,671	581,609
1918 ..	..	398	157,940	13,605	24,542	6,408	28,487	605,546
1919 ..	..	..	..	18,191	21,222	..	30,339	485,949

The United States returns include a large proportion of anthracite, the quantity averaging for the last five years about 82 million tons.

Including New Zealand the production from Australasia takes second place amongst the possessions of the British Empire, British India coming first in order.

4. *Export of Coal.*—The exports of coal from the Commonwealth are practically confined to New South Wales.

The total quantity of coal of Australian production (exclusive of bunker coal) exported from the Commonwealth to other countries in 1919 was 778,645 tons, valued at £615,621, of which amount 778,035 tons, valued at £614,981, were exported from New South Wales. Owing to disturbed conditions consequent on the war the figures are, of course, considerably below those of normal years.

In the following table will be found the quantity and value of the exports from New South Wales, at decennial intervals since 1881 and 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 of the Commonwealth :—

#### EXPORTS OF NEW SOUTH WALES COAL, 1881 TO 1919.

Year .. .. .	1881.	1891.	1901.	1911.	1915.	1916.	1917.	1918.	1919.
Quantity, 1,000 tons ..	1,030	2,514	3,471	5,024	4,668	3,434	3,264	3,422	3,503
Value, £1,000 .. ..	417	1,307	1,682	2,664	2,485	1,873	2,384	2,525	2,919

The principal oversea countries to which coal was exported from New South Wales during the year 1919-20 are as shewn hereunder. The quantity and value refer strictly to exports, and exclude bunker coal :—

#### DESTINATION OF NEW SOUTH WALES OVERSEA EXPORTS OF COAL, 1919-20.

Country.	Quantity.	Value.	Country.	Quantity.	Value.
	Tons.	£		Tons.	£
Alaska .. ..	3,015	2,609	Java .. ..	83,727	73,303
Canada .. ..	5,017	3,763	Papua .. ..	4,879	4,309
Chile .. ..	31,314	26,773	New Caledonia ..	28,719	26,118
Straits Settlements	113,233	97,746	Gilbert and Ellice		
Fiji .. ..	40,088	33,929	Islands .. ..	4,932	3,943
New Zealand ..	506,552	392,705	Solomon Islands	1,290	1,320
India .. ..	14,480	12,270	Pleasant Island ..	5,454	4,615
Tonga .. ..	54,364	46,497	Ceylon .. ..	2,543	2,988
Peru .. ..	17,322	14,938	Japan .. ..	3,813	3,473
Philippine Islands	63,988	56,743	Guam .. ..	5,586	4,283
United States ..	21,826	18,840			

The quantity of bunker coal taken from New South Wales by oversea vessels was about 455,000 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 :—

#### DISTRIBUTION OF TOTAL OUTPUT OF NEW SOUTH WALES COAL, 1915 TO 1919.

Year.	Exports to Australasian Ports.	Exports to other Ports.	Local Consumption.	Total.
	Tons.	Tons.	Tons.	Tons.
1915 .. ..	2,601,070	2,067,324	4,780,614	9,449,008
1916 .. ..	2,203,659	1,230,439	4,693,063	8,127,161
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	5,128,526	8,631,554

The figures quoted above are given on the authority of the New South Wales Mines Department. Owing to the abolition of the record of interstate trade it is impossible to give the quantities forwarded to each of the States of the Commonwealth.

5. **Consumption of Coal in Australia.**—An estimate of the consumption of coal in the Commonwealth 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 shews the consumption of coal in Australia, computed in the manner specified, for the last five years :—

**CONSUMPTION OF COAL IN AUSTRALIA, 1915 TO 1919.**

Year.				Quantity of Coal Consumed.		
				Home Produce.	Produce of Other Countries.	Total.
				Tons.	Tons.	Tons.
1915	..	..	..	9,250,592	6,580	9,257,172
1916	..	..	..	8,266,215	11,068	8,277,283
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

The bunker coal taken away in 1919 is estimated at 751,000 tons.

6. **Price of Coal.**—(i) *New South Wales.* The price of coal in New South Wales has been subject to considerable fluctuation since the date of first production. Up to the end of 1857 the average value of the total output was 11s. 10d. per ton. Next year the value had risen to nearly 15s., declining thereafter until in 1871 the price realised was 7s. From 1872 to 1879 there was a rise in value to 12s. Between 1882 and 1891 the price ranged between 8s. and 10s. From 1891 onwards there was a steady decline until 1898, when the average was 5s. 4d. Henceforward prices rose again until 1902, when 7s. 5d. was the average. A decline then set in until 1905, when the price stood at a little over 6s., followed by a rise of one penny in 1906, and a further rise of eightpence in 1907. In 1908 the average was 7s. 4d., in 1916, 8s. 2d., while in 1917 the price advanced to 10s. 8d. per ton, the highest recorded since 1879. In 1918 there was a further rise to 10s. 11d., and in 1919 to 12s. 7d. The price of New South Wales coal depends on the district from which it is obtained, the northern (Newcastle) coal always realising a much higher rate than the southern or western product. The average rate in each district during the last five years was as follows :—

**PRICE OF COAL, NEW SOUTH WALES, 1915 TO 1919.**

Year.				Northern District.	Southern District.	Western District.
				Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
1915	..	..	..	7 7.24	6 11.23	5 6.08
1916	..	..	..	9 0.72	7 1.77	5 6.90
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

(ii) *Victoria.* In Victoria the average price of coal up to the 31st December, 1890, was 19s. 3d. per ton. In 1895 the price was still as high as 12s. 2d., but in the following five years there was a serious decline, the value in 1900 being quoted at 9s. 7d. per ton. In 1901, however, there was an astonishing rise, the figure being as high as 14s. 7d. Since that year, however, the price again declined up to 1916, the average for 1905 being 10s. 2d.; for 1909, 12s.; for 1912, 8s. 9d.; for 1913, 9s. 3d.; for 1914 and 1915, 9s. 4d.; and for 1916, 10s. 4d. In 1917, however, the price rose to 14s. 5d., in 1918 to 15s. 11d., and in 1919 to 17s. 7d. per ton. These averages are exclusive of brown coal, the production of which in 1919 was valued at 6s. 2d. per ton.

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

PRICE OF COAL, QUEENSLAND, 1915 TO 1919.

District.	Value at Pit's Mouth.				
	1915.	1916.	1917.	1918.	1919.
	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
Ipswich .. ..	7 3	7 11	10 8	11 0	12 7
Darling Downs .. ..	8 11	9 10	12 9	13 5	14 10
Wide Bay and Maryborough	11 10	12 2	15 10	16 9	19 2
Rockhampton .. ..	8 6	9 6	11 10	12 4	13 4
Clermont .. ..	7 8	7 9	11 5	10 5	11 2
Bowen .. ..	.. ..	.. ..	.. ..	.. ..	15 0
Mount Mulligan (Chillagoe)	12 7	13 4	15 6	16 6	17 8
Average for State ..	8 0	8 7	11 5	11 8	13 2

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

(iv) *Western Australia.* The average price of the Collie (Western Australia) coal up to the end of 1901 was 9s. 4d. per ton, the price in 1901 being 11s. 7d. In 1902 the average stood at 12s. 3d., and from that time the price fell steadily until 1906, when it was 7s. 7½d. per ton. In 1907, the average price was 7s. 8½d.; in 1908, 8s. 7½d.; in 1909, 8s. 5½d.; in 1910, 8s. 8d.; in 1911, 8s. 10d.; in 1912, 9s. 2d.; in 1913, 9s. 9d.; in 1914, 9s. 4d.; in 1915, 9s. 8d.; in 1916, 9s. 9d.; in 1917, 11s. 9d.; in 1918, 12s. 1d.; and in 1919, 13s. 5d. per ton.

(v) *Tasmania.* The average price per ton of coal at the pit's mouth in Tasmania was 8s. in 1901. In 1902 it was 8s. 7d.; in 1903, 8s. 9d.; in 1904 and 1905, 9s. 8d.; in 1906, 9s. 9d.; in 1907, 1908, and 1909, 8s.; in 1910, 11s. 9d.; in 1911 and 1912, 9s. 2d.; in 1913, 9s. 3d.; in 1914, 9s. 2d.; in 1915, 9s. 5d.; in 1916, 9s. 9d.; in 1917, 12s. 2d.; in 1918, 12s. 6d.; and in 1919, 14s. 2d. per ton.

7. *Price of Coal in the United Kingdom.*—During the five years 1914–18 the average value of coal at the pit's mouth in the United Kingdom has risen rapidly, the price in 1914 being 10s.; in 1915, 12s. 6d.; in 1916, 15s. 7d.; in 1917, 16s. 9d.; and in 1918, 20s. 11d. 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 1919 is shewn below. The table also shews the number of persons killed and injured, with the proportion per 1,000 employed, while further columns are added shewing 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.

Returns published by the Board of Trade, England, some years ago, gave the total known number of persons engaged in coal mining in the principal countries of the world as 3½ millions, the number in the United Kingdom being 1,068,000; the United States, 723,000; Germany, 628,000; France, 199,000; Russia, 169,000; Belgium, 146,000; Austria, 75,000; India, 133,000; and Japan, 145,000.

The latest available returns shew the rate in the United Kingdom in respect of deaths through accidents in coal mines as 1.40, and for the British Empire 1.48 per 1,000 persons employed in coal mines. For France the rate is given as 1.17, for Germany 2.30, and the United States 3.35. For foreign countries generally the rate is stated at 2.48 per 1,000.

## EMPLOYMENT AND ACCIDENTS IN COAL MINING, 1919.

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	18,178	17	100	0.94	5.50	508,000	86,000
Victoria ..	2,192	5	13	2.28	5.93	107,000	41,000
Queensland ..	2,259	9	28	3.98	12.39	104,000	33,000
Western Australia	726	1	118	1.38	162.53	402,000	3,000
Tasmania ..	209	..	9	..	43.06	..	7,000
Commonwealth ..	23,564	32	268	1.36	11.37	330,000	39,000

The figures for New South Wales include a small number of shale miners.

## § 11. Coke.

1. Production of Coke.—Notwithstanding the large deposits of excellent coal in Australia, there was, prior to the war, a fairly considerable amount of coke imported from abroad. In 1918–19, however, the import was negligible. The table hereunder gives the production in New South Wales during the last five years :—

## COKE MADE IN NEW SOUTH WALES, 1915 TO 1919.

Year	1915.	1916.	1917.	1918.	1919.
Quantity .. .. tons	417,753	437,587	455,587	608,492	424,773
Value, total .. .. £	313,241	387,571	541,093	647,798	550,127
Value per ton .. ..	15s. 0d.	17s. 9d.	23s. 9d.	21s. 4d.	25s. 11d.

During the last five years the industry has made considerable progress. It provides a profitable means of disposal for the small coal which until recent years was allowed to go to waste.

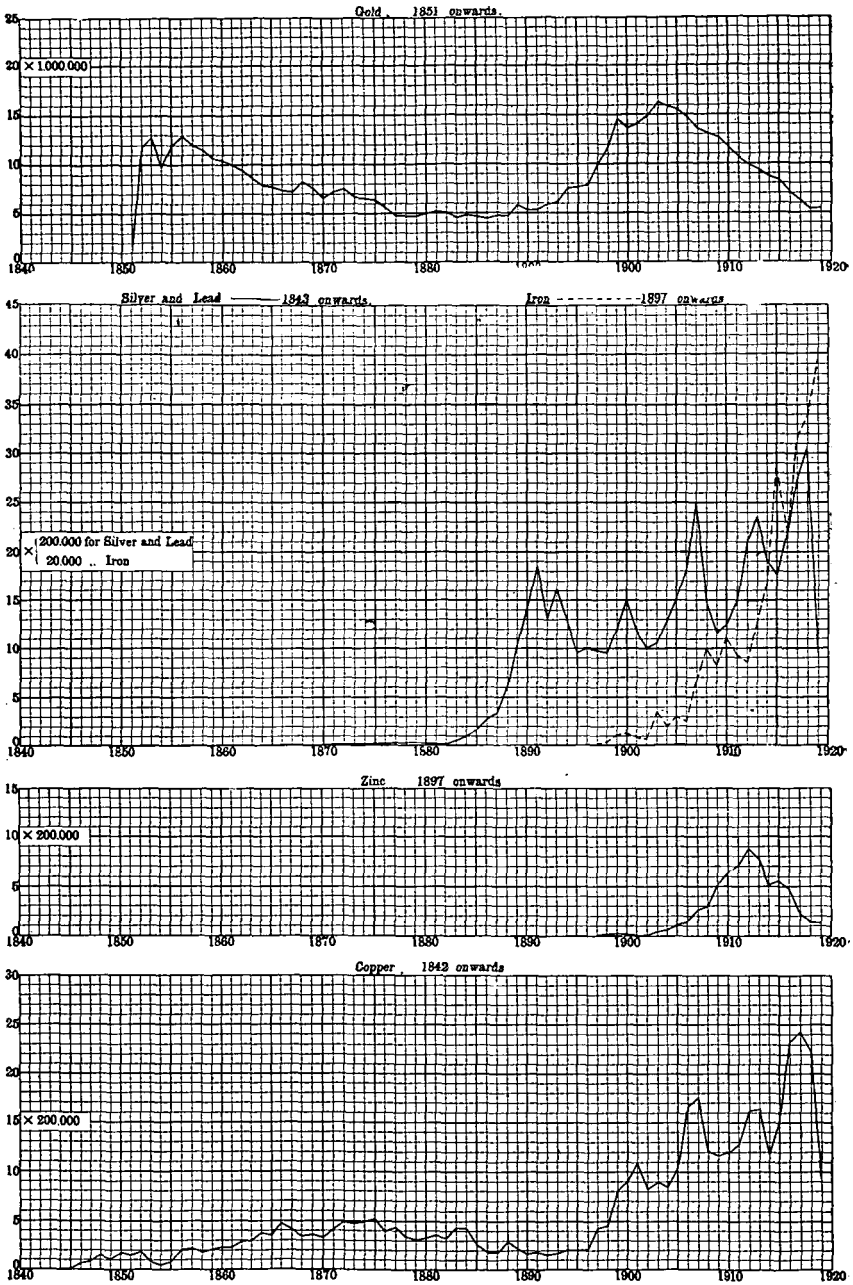
A small quantity of coke is made in Queensland, the quantity returned in 1919 being 4,562 tons, but the bulk of that used in ore reduction is imported, mainly from New South Wales. The following table shews the amount manufactured locally during the last five years :—

## QUEENSLAND.—COKE MANUFACTURED, 1915 TO 1919.

Year .. ..	1915.	1916.	1917.	1918.	1919.
Manufactured locally tons	17,085	17,904	13,399	14,437	4,562

It is estimated that the total amount of coke consumed for smelting purposes in Queensland during 1918 was 74,000 tons, of which 14,000 tons were produced locally, and 60,000 tons were imported from New South Wales. Records of importation during 1919 are not available.

GRAPHS SHEWING VALUES OF THE PRINCIPAL MINERALS PRODUCED IN THE COMMONWEALTH, 1840 TO 1919.

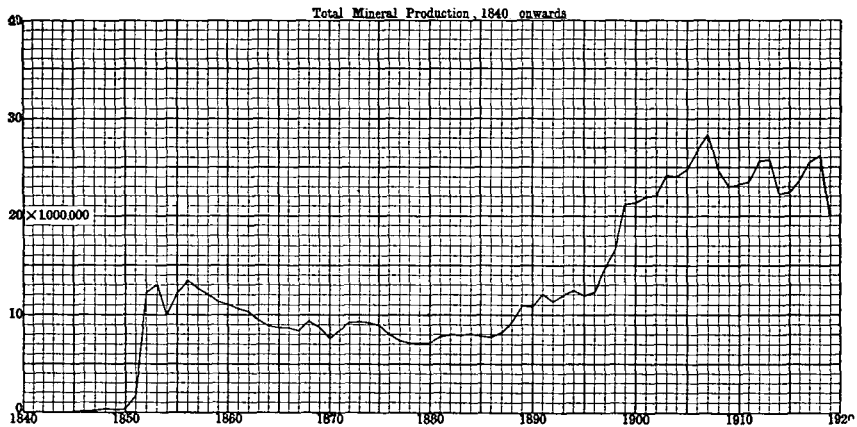


(See pages—for gold, 340; silver, 348; iron, 358; zinc, 357; copper, 351.)

EXPLANATION OF GRAPHS.—The values shewn in the above diagrams are those of the total Commonwealth production of certain of the most important minerals in successive years from 1840 to 1919.

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 £20,000.

GRAPHS SHEWING VALUES OF THE PRINCIPAL MINERALS PRODUCED IN THE  
COMMONWEALTH, 1840 TO 1919—*continued.*



(See pages 364 for coal ; 354 for tin ; and 339 for total mineral production.)

EXPLANATION OF GRAPHS.—The values shewn in the above diagrams are those of the total Commonwealth production of certain of the most important minerals in successive years from 1840 to 1919.

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.

## § 12. Oil Shale and Mineral Oils.

1. **Production of Shale.**—(i) *New South Wales.* As pointed out by Mr. E. F. Pittman, the name kerosene shale has been rather inaptly applied to a variety of torbanite, cannel, or boghead mineral found at various geological horizons in New South Wales. The mineral does not, as a rule, split in parallel layers, the fracture being rather of a conchoidal type. Pure samples have been found to contain over 89 per cent. of volatile hydro-carbons. The discovery of the mineral in New South Wales dates probably as early as 1802. Its occurrence in the Hartley Vale district was noted by Count Strzelecki in 1845. The mineral has been found at several places in the Upper Coal Measures, and in at least two in the Lower Carboniferous. Production on anything like a large scale commenced in 1868, when about 17,000 tons, valued at £48,000, were raised. The production in 1919 amounted to 25,453 tons, valued at £37,968, as compared with 32,395 tons, valued at £39,676, in 1918. For 1919 the whole of the production came from the Western District.

(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 has fostered the hope that energetic development will lead to the discovery of mineral oil in quantity in this locality. During 1919 the bore reached a depth of 3,705 feet, but at the latest available date further drilling operations were suspended owing to the tools getting fast in the bore. Oil-bearing shales are common in many parts of the State. The deposit at Duaringa on the Central railway line shewed a thickness of 6 feet, and contained about 30 gallons of oil to the ton. Inflammable gas and a little oil have been noted in bores put down for coal on the Dawson River. There are shale deposits at Munduran Creek, near Gladstone, Casuarina Island, Redbank Plains in the Ipswich District and Murphy's Creek, near Toowoomba. It is stated that the borings have not so far penetrated to a sufficient depth to properly test the strata.

(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. A bore has been put down to a depth of over 4,000 feet, with negative results, by the South Australian Oil Wells Co. A large number of licenses to search for oil was taken out some years ago and bores were put down near Kingston and near Robe.

(v) *Western Australia.* A deposit of carbonaceous shale of considerable thickness is known to exist at Coolgardie, but the mineral has not yet been raised in any quantity. It is stated that small seepages of oil have been noted near Wonnerup, and indications have been reported from the neighbourhood of Albany and Esperance.

(vi) *Tasmania.* Tasmanite shale has been discovered in the basins of the Mersey, Don, and Minnow Rivers, and the Government Geologist estimates the probable capacity of the beds at 12,000,000 tons. The crude oil content of average quality shale has been estimated at 40 gallons to the ton. In July, 1912, the Railton-Latrobe Shale Oil Company acquired the leases and plant of the Tasmanian Shale and Oil Company, at Latrobe, and it was proposed to develop the deposits on a large scale. The production in 1914 was, however, small, amounting to 75 tons, valued at £75, while no returns from this source were included in the production records for 1915. In 1916, the Company raised 1,286 tons of shale, valued at £1,286, and in 1919, 600 tons valued at £900. Large pieces of asphaltum have been discovered in places along the sea coast and in several of the bays of Port Davey Harbour, but it is believed that the material originates in submarine beds. A bore was put down in 1916 by a private company on Bruni Island in search of petroleum, but after sinking about 429 feet, operations ceased for lack of funds.

In 1917 a deposit of tasmanite shale was located on the Cam River.



(vii) *Northern Territory.* The existence of oil shale has been reported in the Borooloola district, and several oil licenses were applied for some years ago in the Victoria River district. Results were, however, negative, and experts have pronounced unfavourably on the prospects.

(viii) *Papua.* Many indications suggest that oil-bearing strata exist over an extensive area in the Gulf Division of Papua. Seepages of oil and natural gas are known, and, in addition, light oil of excellent quality has been obtained from sandy strata encountered in most of the prospecting bores put down under the direction of the Commonwealth Government. Reconnaissance surveys have been made of the country where evidences are known to exist, while selected areas are being surveyed in greater detail. Several test bores have been sunk, the deepest being over 1,800 feet; in each case quantities of inflammable oil and gas have been met with, but so far not in sufficient bulk for commercial purposes. (See also Section XXIX., Papua.)

2. *Export of Shale.*—In 1916–17 New South Wales exported a small quantity of shale. There was no export in the succeeding year, and in 1919, 5 tons were exported valued at £21.

3. *Shale Oil Bounties.*—The Shale Oils Bounties Act 1910 provided for the payment of bounties on certain goods manufactured in Australia from Australian shale on or after the 1st July, 1910, and before the 1st July, 1913. The total amount made available for bounties under this Act was £50,000. During the year 1913, the bounties paid in New South Wales amounted to £985 on 118,000 gallons of kerosene, and £809 on 324 tons of refined paraffin wax. Under the Shale Oil Bounty Act of 1917 a sum of £270,000 was provided for bounty on crude shale oil at various rates. Bounty to the amount of £26,407 was paid on 2,816,718 gals. of crude shale oil in 1918–19.

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. 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 gals. of crude petroleum containing not less than 90 per cent. of products obtainable by distillation.

### § 13. Other Non-Metallic Minerals.

1. *Alunite.*—Probably the most remarkable deposit of alunite in the world occurs at Bullahdelah, in the county of Gloucester, New South Wales, a large proportion of a low bluff ridge in the district being composed of this mineral. The deposits are worked by quarrying, and from 1890 up to the end of 1919, 54,000 tons had been exported, valued at £191,000, the exports for the year 1919 being 2,485 tons, valued at £14,910.

Deposits of a high-class alunite are reported to have been discovered near Sunbury, in Victoria.

According to the Geologist's report, apart from its scientific interest, no commercial importance attaches to the presence of natural alum over the area examined near Boonmoo, on the Chillagoe Railway in Queensland.

In South Australia an extensive deposit of the mineral was located in 1913 at Carrickalinga Head, on the coast north of Normanville, and within a short distance of Adelaide. Fresh discoveries were recently reported on the western shores of St. Vincent's Gulf. It is stated that the specimens so far analyzed have proved richer in valuable constituents than any similar find yet recorded. The mineral returns for 1917 shew a small production, but none was recorded in 1918 and only 60 tons in 1919.

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 1,527 tons of fibrous rock, which on treatment yielded 123 tons of fibre valued at £1,500, were raised by a company from deposits in the Barraba division. A small quantity was also raised in 1919 at Lewis Ponds in the Orange division. In Queensland seams of asbestos have been found over a belt of country extending from Cawarral to Canoona, as well as in other districts. Samples of the fibre proved suitable for the manufacture of fibro-cement, sheeting, and tiles, but so far the deposits have not been commercially exploited. In Western Australia a deposit of the fibrous chrysolite variety was located at Soanesville, on the Pilbara goldfield, and £154 worth of this mineral was raised in 1909. The discovery of a deposit of commercial quality was reported from

the Nullagine district in 1917; about 50 tons, valued at £1,400, were produced in 1919. 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. Deposits of asbestos of the mountain leather and mountain cork varieties have been discovered at Oodlawirra, while deposits of a good blue variety have been discovered near Hawker and about 23 miles from Eudunda, in South Australia.

3. **Barytes.**—In New South Wales during 1919 about 579 tons of barytes, valued at 1,851, were obtained, of which 400 tons were raised at Mandurama in the Cowra division, and 179 tons at Lue in the Mudgee division, while small quantities were raised in the Cooma and Braidwood divisions. The production in South Australia during 1919 was given as £5,264. In this State there are extensive deposits of the mineral in the Willunga and other districts. About 399 tons of barytes were produced in Tasmania in 1919.

4. **Clays and Pigments.**—Valuable deposits of clays and pigments of various sorts are found throughout the Commonwealth. 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 kaolin in 1919 amounted to 2,254 tons valued at £3,243, of which 500 tons, valued at £1,000, were raised at Morongla Creek in the Cowra division, and 373 tons, valued at £485 were raised in the Murrumburrah division. Production was also recorded from the Parkes, Gulgong, Gunning, Goulburn, Mudgee, and Sydney divisions. Deposits of steatite were worked during 1919 in the Murrumburrah division, the quantity raised during the year at Wallendbeen amounting to 200 tons, while 150 tons were produced in the parish of Wallendoon, County Harden. Near Morangaroo 5,000 tons of silica were raised by the Silica Fire Brick Company. Extensive deposits have been located in the parishes of Conyola and Ulladulla in the Milton division. About 200 tons of ochre, valued at £300, were raised in the Dubbo division; 165 tons of red ochre were raised near Glen Innes, and 60 tons of red oxide of iron at Granville, near Sydney. In Victoria 950 tons of kaolin were obtained at Egerton, 240 tons at Stawell, 700 tons at Pyalong, and 101 tons at Carngham, the total value of the production being given at £2,255. A small quantity of pigments was raised from leases in the Balnarring and Knowsley areas. In Queensland, 8,368 tons of fireclay, valued at £2,051, were mined during the year 1919, the whole of which was obtained in the Mount Morgan district. On Kangaroo Island, South Australia, where, it is stated, the first pottery mill in the Commonwealth 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 suitable for making coloured tiles are found near Port Noarlunga. Porcelain and other clays of good quality have been found in Tasmania at Beaconsfield, Sorell, Hagley, etc. Deposits of ochre have been opened up at Dubbo, Wellington, and Marulan, in New South Wales, and ochres and pigments of excellent quality have been produced therefrom. Extensive deposits of iron oxide, giving a return of 80 per cent. ochre, have been discovered near Oodlawirra in South Australia. Oil and water paints of good quality have been made from coloured ochres from Sorell, in Tasmania, and a deposit of ochre of good quality has been located near Mowbray. A company is making paints from the latter deposits, and also from deposits on leases near Ilfracombe. At Kingston a valuable clay deposit has been opened up.

5. **Coorongite.**—This peculiar india-rubber like material was first noted many years ago near Salt Creek and in the vicinity of Coorong Inlet, in South Australia, as well as at various localities on Kangaroo Island. It was thought that the substance owed its origin to subterranean oil-bearing strata, but so far the search for petroleum has not been attended with success. (See also § 12, 1 (iv.)) While the origin of coorongite is still in doubt, it is held by some observers that it originates from the blue-green algae which frequently abound in swamps and shallow inland waters. Similar material has been found in Portuguese East Africa, and on the shores of lakes in Siberia.

6. **Fuller's Earth.**—Small quantities of this material were produced in 1917, from leases in the Narrabri division, New South Wales.

7. **Graphite.**—Graphite is found in New South Wales near Undercliff Station, in the county of Buller, and 100 tons raised during 1919 realised £100 per ton.

Owing to the low grade of the ore there is only a limited market for it. In Victoria the mineral occurs in Ordovician slates in several of the goldfields, 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. 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 shews 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 a marketable graphite. In Western Australia deposits occur at Munglinup Creek, near the Oldfield River, at Northampton, in the Murchison division, and on the Donnelly River, at Kendenup, about 40 miles from Albany. At the last-mentioned locality, where the ore is of good grade, a fair amount of developmental work has been done, but the export in 1918 was small, amounting to 5 tons, valued at £75, and none of the mineral was exported in 1919.

8. **Gypsum.**—This mineral is found in various places in the Commonwealth. It occurs in two forms, large crystals, and a floury earth consisting of minute crystals and known as "copi." Both forms are exceedingly pure. It is used largely as a natural manure and to some extent in the manufacture of Portland cement. Gypsum, or hydrous sulphate of lime, when burnt, forms plaster of Paris. In Victoria during 1919 there was a production of 820 tons, valued at £482, obtained chiefly at Lake Boga. Numerous deposits of gypsum are found in Southern Yorke's Peninsula in South Australia. The production in 1919 was valued at £18,725. A factory for the manufacture of plaster of Paris has been erected by the Permasite Co. on its lease at Dry Bone Lake. A deposit of gypsum sand containing practically an inexhaustible supply is found on the edge of Lake Austin in Western Australia.

9. **Magnesite.**—Deposits of this mineral have been discovered at several localities in New South Wales. During 1919, 3,435 tons, valued at £5,093, were raised in the Fifield division, and 5,829 tons, valued at £2,939, at Attunga, in the Tamworth division. The mineral is found at Heathcote in Victoria, where 77 tons, valued at £231, were produced in 1919. 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 1919 amounted to 273 tons, valued at £508. During 1915, 688 tons of magnesite, valued at £1,196, were exported from Western Australia, but the export in 1916 amounted to 12 tons only, in 1917 to 42 tons, in 1918 to 62 tons, while none was exported in 1919. A large area of magnesite bearing country has been located at Bulong, about 20 miles east of Kalgoorlie.

10. **Tripolite, or Diatomaceous Earth.**—Although tripolite has been found at Barraba, Cooma, Wyrallah, and in the Warrumbungle Mountains in New South Wales, the deposits have not been worked commercially on any considerable scale. From the deposits at Middle Flat, in the Cooma division, 88 tons of diatomaceous earth, valued at £246, were produced in 1919, and small quantities were obtained in the Coonabarabran and Narrabri divisions. In Victoria there is a remarkably pure deposit at Lillieur, 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 1919, a production of 140 tons, valued at £560, was recorded. Fairly extensive deposits of diatomite exist in Queensland, in the Nerang, Beaudesert and Canungar areas, but the various outcrops have as yet been only partially examined. In Tasmania a deposit of diatomaceous earth has been located at Oatlands, but its use for the manufacture of explosives is apparently prejudiced by the circumstance that the diatoms are pulverised and contaminated with clay.

11. **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 69,000 tons of crude salt were produced during 1919. In Western Australia supplies are obtained from dried-up shallow lakes and consumed locally or exported. The chief centres of production were formerly Rottnest Island, near Fremantle, Middle Island, near Esperance, and Port Gregory; but during recent years the bulk of the demand has been supplied from imports.

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

**12. Natural Manures.**—Gypsum has already been referred to (see 8 *ante*). South Australia possesses deposits of rock phosphate near Port Clinton and Ardrossan on Yorke Peninsula, at Belvedere near Kapunda, and at Koorunga, and also at many other places which have only been prospected to a small extent. The production in 1919 was 5,950 tons, valued at £8,982. Phosphate of lime has been found in small quantities chiefly in the limestone caves of New South Wales. The production in 1919 amounted to 576 tons of phosphate rock, valued at £2,016, raised by the Canowindra Phosphate Co. in the Cowra division. In Victoria, about 2,500 tons of phosphate rock were raised in 1919 at Mansfield. Although it can hardly be considered a mineral product, mention may be made here of the large accumulations of guano on the Abrolhos Islands, off the coast of Western Australia, in the neighbourhood of Geraldton. The deposits vary in thickness from four to twenty-seven inches. During the years 1876-80 over 36,000 tons were raised; no figures are available shewing the quantity raised in recent years.

## § 14. Gems and Gemstones.

**1. Diamonds.**—Diamonds were first noted in New South Wales by E. J. Hargraves in 1851, and in October of the same year by Geological Surveyor Stutchbury. The Cudgong field was discovered in 1867, and shortly afterwards the Bingara diamondiferous deposits were located. Stones of small size are also found at Cope's Creek and other places in the Inverell district. The largest diamond won in New South Wales was reported to have been obtained in 1905 at Mt. Werong, near Oberon, and weighed 28  $\frac{1}{2}$  carats. It is difficult to secure accurate returns in connexion with the production of precious stones, but the yield of diamonds in 1919 was estimated at 1,774 carats, valued at £1,706, while the total production to the end of 1919 is given at 195,413 carats, valued at £133,987. The yield in 1919 was contributed by miners working in the vicinity of Copeton, in the Tingha division. Small quantities of diamonds are found in Victoria in the gravels of streams running through granite country in the Beechworth district, at Kongbool in the Western District, and near Benalla. The stones are generally small and the production up to date has been trifling. In 1912, eleven small diamonds, valued at £20, were picked out of the sluice boxes of the Great Southern alluvial mine at Rutherglen. A few small diamonds have been found in the Pilbara district in Western Australia. In South Australia diamonds have been found on the Echuunga 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.**—These gems were discovered in New South Wales in 1851, near Burrandong. They have also been found in small quantities near Inverell, and at a few other localities in the State. During 1919, 1,150 carats of sapphires were obtained at Swamp Oak in the Inverell division. Specimens of sapphire have been found in Victoria, but the stones of commercial size are generally of little value owing to flaws.

In Queensland sapphires are found in the gravel of creek beds, between Withersfield and Anakie on the Rockhampton-Winton railway line. The gems shew excellent fire and lustre, but the colour is darker blue than the Oriental sapphire. Hyacinths are occasionally found in association with the gems. The production of sapphires in Queensland in 1919 was valued at £42,883 as compared with £600 in 1915, and over £40,000 in 1913. The gem mining industry practically collapsed on the outbreak of the war, as the German buyers ceased business. With the opening up of markets in London and Paris,

however, matters assumed a more satisfactory footing and business remained fairly satisfactory in 1918. During 1919, owing to the keen demand for the gems, prices rose rapidly. It is stated that the increased demand was partly due to the circumstance that many persons in Europe were converting their assets into gems, in view of the international value possessed by the latter, and was partly brought about by development of the gem-cutting industry in France and England. The output of sapphires in 1919 was valued at £42,883, as compared with £16,591 in 1918.

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.**—This stone was first discovered in New South Wales at Rocky Bridge Creek on the Abercrombie River, in the year 1877, and later a most important discovery was made at White Cliffs in the Wilcannia district, which, for a time, contributed the bulk of the production. In 1919, however, out of a total production valued at £27,552, the yield from the Lightning Ridge field, near Walgett, amounted to £25,000, while the output from the White Cliffs field was £1,900. A new field was opened up in 1919 in the Ballina division, and about £600 worth of opal was raised therefrom. 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. 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 £1,475,000.

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

In Queensland, the first recorded discovery of the gem dates from about 1875. The opaliferous district stretches over a considerable area of the western interior of the State, from Kynuna and Opalton as far down as Cunnamulla. The yield in 1919 was estimated at £600, and up to the end of that year at about £179,000. These figures are, however, merely approximations, as large quantities of opal are disposed of privately to buyers on the fields, no record of which is obtained. At present, the industry 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 limited by the difficulty in obtaining sufficient water.

Precious opal has been discovered in South Australia in a locality 144 miles N. by E. of Tarcoola. The specimens show similar characteristics to those obtained at White Cliffs in New South Wales. Production in 1919 amounted to about £20,000.

**4. Other Gems.**—Emeralds were found in New South Wales in the year 1890, near the township of Emmaville, the largest specimen found in the district weighing 23 carats in the rough. Altogether 2,225 carats were sent to London during that year, some of the gems bringing £4 a carat, but the production has since dwindled. The mine at the Glen in the Emmaville division was re-opened and worked for a short period during 1908, when about 1,000 carats of emeralds, valued at about £1,650, were obtained. The largest stone in the rough weighed 60 carats. Small emeralds of fine quality have been found at Poona, in Western Australia, and it is stated that prospecting at greater depths would possibly reveal the existence of larger specimens. Amongst other gems found in New South Wales at various times may be mentioned *turquoises*, discovered in 1894, near Bodalla; *topazes*, fine specimens of which have been obtained in the New England district; and *zircon*s and *garnets*. Zircons of small size are plentifully found in the vicinity of Table Cape in Tasmania. Topazes are common in the tin drifts of Tasmania, and some fine specimens have been found. Turquoises are also found in thin veins in Victoria. In Gascoigne's mine, situated near the King River, in the parish of Edi, samples of the gem have been found equal in colour to the best Persian stone, and a considerable quantity of turquoises from this mine has been sold in England and Germany. Fine *agates* are found in many places in Victoria, but have not been made use of to any extent. These gems also occur plentifully in the bed of Agate Creek, about four miles south of Forsayth, on the Etheridge field in Queensland. Garnets are found in Western Australia, and beautiful specimens of *crocidolite* have been obtained at Yarra Creek in the Murchison district. *Rubies* have been found at various places in New South

Wales and Queensland. *Tourmaline* has been found on Kangaroo Island, in South Australia, and *beryls* near Williamstown, Victoria, and at Poona in Western Australia. Very large but impure beryl crystals have been found at Ben Lomond in Tasmania. Some fine samples of *chiastolite* or luck stone have been found at Mt. Howden, near Bimbourie, in South Australia.

## (C) GENERAL.

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

1. Total Employment in Mining.—The number of persons engaged in the mining industry in each State and in the Commonwealth 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 1919 the number so employed was as follows:—

NUMBER OF PERSONS ENGAGED IN MINING, 1919.

State.	Number of Persons Engaged in Mining for						Total.
	Gold.	Silver, Lead, and Zinc.	Copper.	Tin.	Coal and Shale.	Other.	
New South Wales ..	1,656	6,556	1,148	2,171	18,178	2,750	32,459
Victoria ..	3,065	..	..	38	2,192	211	5,506
Queensland ..	792	145	2,521	1,114	2,259	1,190	8,021
South Australia ..	100	..	400	..	..	800	1,300
Western Australia ..	7,242	74	72	209	726	23	8,346
Tasmania ..	73	798	1,571	1,303	209	459	4,413
Northern Territory ..	60	3	12	190	..	257	522
Commonwealth ..	12,988	7,576	5,724	5,025	23,564	5,690	60,567

The following table shews the number of persons engaged in mining in the Commonwealth during each of the years 1891, 1901, and 1919, 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, and largely also to the decline in the gold-mining industry:—

PROPORTION OF PERSONS ENGAGED IN MINING, 1891, 1901, AND 1919.

State.	1891.		1901.		1919.	
	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	32,459	1,621
Victoria ..	24,649	2,151	28,670	2,381	5,506	368
Queensland ..	11,627	2,934	13,352	2,664	8,021	1,106
South Australia ..	2,683	834	7,007	1,931	1,300	278
Western Australia ..	1,269	2,496	20,895	11,087	8,346	2,516
Tasmania ..	3,988	2,695	6,923	4,017	4,413	2,036
Northern Territory ..	..	..	..	..	522	..
Commonwealth ..	74,820	2,341	113,462	2,992	60,567	1,154

2. Wages Paid in Mining.—Particulars regarding wages paid in the mining industry, which in earlier issues of the Year Book were given in this section, have now been transferred to the section dealing with Labour and Industrial Statistics.

3. **Accidents in Mining, 1919.**—The following table gives particulars of the number of men killed and injured in mining accidents during the year 1919:—

**NUMBERS KILLED AND INJURED IN MINING ACCIDENTS, 1919.**

Mining for—	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N. T.	C'wealth.
<b>KILLED.</b>								
Coal and shale	17	5	9	..	1	..	..	32
Copper ..	..	..	1	..	..	1	..	2
Gold ..	..	4	..	..	25	..	..	29
Silver, lead, and zinc ..	6	..	..	..	..	..	..	6
Tin ..	..	..	..	..	..	..	..	..
Other minerals	..	1	..	..	..	..	..	1
<b>Total ..</b>	<b>23</b>	<b>10</b>	<b>10</b>	<b>..</b>	<b>26</b>	<b>1</b>	<b>..</b>	<b>70</b>
<b>INJURED.</b>								
Coal and shale	100	13	28	..	118	9	..	268
Copper ..	..	..	14	..	..	31	..	45
Gold ..	2	9	11	..	476	..	..	498
Silver, lead, and zinc ..	14	..	..	..	1	1	..	16
Tin ..	1	..	..	..	..	10	..	11
Other minerals	1	3	..	..	..	6	..	10
<b>Total ..</b>	<b>118</b>	<b>25</b>	<b>53</b>	<b>..</b>	<b>595</b>	<b>57</b>	<b>..</b>	<b>848</b>

**§ 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 1919 the total sum expended in this manner amounted to £498,127, of which £8,691 was advanced in 1919.

3. **Victoria.**—Since the inception of the Mining Development Act in 1897, the expenditure under its varying provisions has been £733,605, of which £339,635 was disbursed in connexion with advances for prospecting, £211,210 on boring, £69,603 on testing plants, £62,841 on roads and tracks, and £50,316 on purchase of cyanide plant, equipment of School of Mines, and miscellaneous. In 1920–21, £17,617 was expended as follows:—Construction and maintenance of State batteries, £4,611, boring, £11,180, advances to companies and private parties, £1,000, and £826 in geological and other surveys; in addition, £14,000 was lent to the Morning Star Gold Mine at Woods' Point, of which £3,000 has been repaid.

4. **Queensland.**—State assistance to the mining industry in 1919 amounted to £27,819, of which £8,808 consisted of loans in aid of deep sinking; £11,195 grants in aid of prospecting; £1,251 in aid of roads and bridges to gold and mineral fields; £3,452 advances under Mining Machinery Advances Acts; and £3,113 in connexion with boring for oil at Roma. At the State battery at Bamford 1,070 tons of tin ore and 253 tons of ore containing wolfram molybdenite were treated in 1919 for a recovery of 25 tons of tin, valued at £3,308, and 90 tons of wolfram, &c., concentrates, valued at £19,915. State assay offices are maintained at Cloncurry and Mareeba. During 1919 the Government acquired the smelters, railways, &c., of the Chillagoe Company.

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 1919 the total amount of subsidy paid was £65,109, of which £11,219 has been repaid, and £2,250 written off, leaving a debit of £51,640. Portion of this amount is represented by machinery that has fallen into the hands of the Government. Repayments are made 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 1919 in accordance with the subjoined statement :—Advances in aid of mining work and equipment of mines with machinery, £7,711; aid to prospectors, £2,328; advances in aid of boring, £352; subsidies paid on stone crushed for the public, £319; miscellaneous, £1,894; making a total of £12,604. The receipts under the Act exclusive of interest payments came to £2,835, of which £2,065 consisted of refunds of advances.

In 1919 there were 32 State batteries in operation. The amount expended thereon up to the end of 1919 was £91,981 from revenue and £286,233 from loan, giving a total of £378,214. During the year receipts amounted to £29,071, and working expenditure to £38,996.

The total value of gold and tin recovered to the end of 1919 at the State plants was £5,245,000, resulting from the treatment of 1,237,000 tons of gold ore and 79,000 tons of tin ore, together with a small amount from residues.

7. **Tasmania.**—Under the Mining Trust Fund Act of 1918 all balances existing at the end of 1918 were taken over from the Aid to Mining Act of 1912, and the various Appropriation Acts of 1913 and 1917. The fund was established for the purpose of assisting prospectors and of making the final payments in connexion with the closing of the State Argent Mine. During 1919 a sum of £2,066 was expended in aid to mining, of which £1,100 was advanced to the No. 6 Argent Prospecting Syndicate, while on the other hand £1,191 was received as royalties from tributers. The sum of £927 was expended on unwatering the State Argent Flat Mine in 1919, making the total expenditure £44,517. The total value of ore sold was £12,226, while royalties received amounted to £2,252, and revenue from sale of plant and stores to £859.

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

8. **Northern Territory.**—During the year 1919–20 the Government expenditure in aid of mining amounted to £4,976, of which £688 represented subsidies; £378 loss on crushing operations at Maranboy battery; £1,233 expenditure on driving and shaft sinking; £2,497 aid to Government prospecting party; and £180 cost of free assays. As it was considered that the method of assisting private prospectors was unsatisfactory the Government took over the control. The Government Prospecting Party was disbanded on the 30th June, 1920, and although no discovery of importance was made, useful information was obtained regarding the Central Tableland area and the headwater valleys and systems of the Katharine, Alligator, Mary, Waterhouse, Roper, and Ferguson rivers.

The Government maintains batteries at Maranboy and Hayes Creek.

## § 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. Estimated Metallic Contents of Ores, etc., Produced in Australia.

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 within the Commonwealth during the five years 1916 to 1920 were as follows:—

LOCAL EXTRACTION OF METALS, 1916 TO 1920.

Metal.			1916.	1917.	1918.	1919.	1920.
Silver	..	ozs.	5,251,604	6,437,079	9,920,486	6,684,888	712,651
Lead, pig	..	tons	107,635	125,100	166,731	82,732	4,077
Zinc	..	tons	5,227	4,131	6,221	6,544	9,665
Copper	..	tons	34,828	35,989	44,018	16,182	24,069
Tin	..	tons	3,879	3,990	4,582	4,102	4,108

2. Metallic Contents of Ores, Concentrates, etc., Exported.—The estimated metallic contents of ores, concentrates, etc., exported or sold for export during the five years 1916–20 are given in the following table:—

ESTIMATED METALLIC CONTENTS OF ORES, CONCENTRATES, ETC., EXPORTED OR SOLD FOR EXPORT, 1916 TO 1920.

Metal.		Contained in—	1916.	1917.	1918.	1919.	1920.
Silver	ozs.	Lead, Silver, Gold Bullion	2,520,563	1,977,603	..	..	141,263
		Lead Concentrates	324,189	..	..	..	..
		Zinc Concentrates	2,093,554	1,582,575	5,666,609	1,161,754	980,891
		Copper Ores	2,980	..	..	..	..
		Total ..	4,941,286	3,560,178	5,666,609	1,161,754	1,122,154
Lead	tons	Lead, Silver, Gold Bullion	30,699	22,766	..	..	1,939
		Lead Concentrates	7,352	..	..	..	4,122
		Zinc Concentrates	12,218	9,138	32,653	7,463	6,345
		Total ..	50,269	31,904	32,653	7,463	12,406
Zinc	tons	Lead Concentrates	1,020	..	..	..	..
		Zinc Concentrates	89,783	64,656	231,448	50,108	42,295
		Total ..	90,803	64,656	231,448	50,108	42,295
Copper	tons	Ores, Matte, etc.	4,399	..	..	..	2,117
Tin	tons	Concentrates	1,459	847	..	..	70

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 1919–20 were as follows:—Antimony ore, 3,450 tons, £80,427 (to United Kingdom); zinc, bars, blocks, and rods, 2,015 tons, £97,589 (of which 1,974 tons went to United Kingdom); zinc concentrates, 29,669 tons, £166,303 (14,110 tons to United Kingdom, 4,895 tons to United States, and 7,880 tons to Japan); copper, ingots, 27,411 tons, £2,765,374 (20,223 tons to United Kingdom and 4,063 tons to Japan); tin, ingots, 3,432 tons, £957,205 (956 tons to United Kingdom and 1,985 tons to United States); lead, pig, 74,030 tons, £2,690,432 (53,264 tons to United Kingdom and 13,468 tons to Japan); lead, matte, 818 tons, £29,093 (to United Kingdom); silver and silver lead concentrates, 1,736 tons, £49,956 (1,578 tons to United Kingdom); molybdenite, 229 tons, £72,962 (136 tons to United Kingdom); scheelite, 327 tons, £58,839 (219 tons to United Kingdom); wolfram, 776 tons, £136,918 (648 tons to United Kingdom); platinum, osmium, iridium, etc., 1,397 ozs., £52,615 (201 ozs. to United Kingdom and 1,196 ozs. to United States); and pig iron, 19,229 tons, £164,419 (17,010 tons to Japan).