

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 large production of gold, silver, copper, and tin, the extent of the coal deposits, the presence of large quantities of iron ore, and the great variety of minerals found in appreciable quantities, suggest that the future history of mining will, in all probability, be even more remarkable than that of the past. For the extent of the total mineral wealth of Australia cannot yet be regarded as well ascertained, since the mineral exploration of the country is, after all, still in its infancy. 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, &c., 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 1917.**—The continuance of the war in 1916 naturally had a very serious effect on the mineral industry in Australia, although this was to some extent compensated for by the high prices ruling for industrial metals, particularly copper. In New South Wales, the returns for 1917 shewed an advance of over £2,000,000 on those for the previous year, due principally to the increased return from silver, lead, and coal. In Victoria, owing to the decline in the gold yield, the returns for 1917 shewed a decrease in production of about £110,000. The Queensland production shewed a decrease of £8,000. South Australia shewed an increase of about £148,000, contributed to most largely by copper and ironstone. For Western Australia the falling-off in 1917 amounted to about £264,000, and was due entirely to the reduced

gold yield. The Tasmanian production shewed an increase in 1917 of about £61,000 over the return for the previous year, the improvement being due to the heavier yield in tin. The table hereunder shews the quantity of the minerals produced in 1917 :—

QUANTITY OF MINERALS PRODUCED IN THE COMMONWEALTH, 1917.

Minerals.	Unit.	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T.¶	C'wealth.
Alunite ..	ton	1,788	..	..	29	..	..	..	1,817
Antimony ore ..	"	301	12,052	..	..	12	..	..	12,365
Asbestos ..	"	5	..	..	..	..	271	..	276
Bismuth ore ..	cwt.	409	..	2,705*	..	10	84	..	3,208
Brown coal ..	ton	..	39,144	..	..	..	..	..	39,144
Chromite ..	"	587	..	756	..	..	..	..	1,343
Coal ..	"	8,292,867	466,220	1,048,473	..	326,550	63,412	..	10,197,522
Coke ..	"	455,587	..	..	..	..	..	..	455,587
Copper (ingot and matte) ..	"	6,576	..	19,062	7,213	535	5,845	..	39,231
Copper ore ..	"	..	..	†	†	966	771	48	1,785
Diatomaceous earth ..	"	140	750	..	..	..	..	..	890
Gold ..	fine oz.	82,171	201,872	179,305	7,145	970,318	14,496	866	1,456,173
Gypsum ..	ton	..	1,187	..	12,770	..	..	..	13,963
Iron (pig) ..	"	45,025	..	..	..	..	..	..	45,025
Iron oxide ..	"	1,431	..	..	..	..	..	..	1,431
Ironstone ..	"	4,482	..	25,065	328,886	..	..	..	357,933
Kaolin ..	"	1,519	1,573	..	1,967	..	..	..	5,059
Lead and silver lead concentrates, etc. ..	"	20,817	..	480	..	4,661	§	..	25,958
Lead and silver ore, concentrates, etc. ..	"	234,881	..	†	622	22	9,576	9	245,110
Limestone flux ..	"	74,440	..	135,703	68,464	..	..	..	278,607
Magnesite ..	"	9,189	74	..	150	42	..	..	9,455
Manganese ore ..	"	3,721	..	21	264	..	..	..	4,006
Mica ..	cwt.	..	..	..	760	..	..	..	760
Molybdenite ..	"	1,405	1,000	2,224	19	280	..	9	4,937
Phosphate ..	ton	2,000	1,525	..	5,101	..	..	..	8,626
Platinum ..	oz.	259	..	..	..	..	..	..	259
Pyritic ore ..	ton	..	..	..	..	3,575	7,686	..	11,261
Salt ..	"	..	†	..	46,858	..	..	..	46,858
Scheelite ..	"	127	..	9	..	†	69	..	205‡
Shale ..	"	31,661	..	..	..	..	..	..	31,661
Silver ..	fine oz.	1,782,004	7,669	241,639	1,825	222,075	..	..	2,255,212
Tantalite ..	cwt.	..	..	..	340	..	..	..	340
Tin (ingot) ..	ton	1,109	..	§	..	..	2,637	..	3,746
Tin ore ..	"	963	139	1,177	..	383	†	270	2,932
Wolfram ..	"	118	22	354	..	..	172	130	796
Zinc, spelter and concentrates ..	"	113,531	..	..	..	..	..	..	113,531

* Including 2,625 cwt. bismuth and wolfram. † Included with metal. ‡ Not available for publication. § Included with ore. ¶ Year ended 30th June, 1917.

The comparative value of the production of minerals raised in each State during 1917 is given in the following table :—

VALUE OF COMMONWEALTH MINERAL PRODUCTION IN 1917.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T.‡	C'wealth.
	£	£	£	£	£	£	£	£
Alunite ..	10,728	..	..	145	..	..	..	10,873
Antimony ore ..	3,738	58,489	..	..	258	..	..	62,485
Asbestos ..	25	..	..	..	..	271	..	296
Bismuth ore ..	9,391	..	*22,469	..	24	895	..	32,779
Brown coal ..	..	10,571	..	..	..	..	..	10,571
Chromite ..	1,468	..	756	..	..	..	..	2,224
Coal ..	4,422,740	335,259	597,360	..	191,822	38,673	..	5,585,854
Coke ..	541,093	..	..	..	..	..	..	541,093
Copper (ingot and matte) ..	814,154	..	2,208,232	902,495	64,860	841,583	..	4,831,324
Copper ore ..	..	..	†	†	20,878	6,171	5,517	32,566
Diamonds ..	2,006	..	..	..	..	..	..	2,006
Diatomaceous earth ..	440	2,600	..	..	..	..	..	3,040

* Including bismuth and wolfram, £21,172. † Included with metal. ‡ Year ended 30th June, 1917.

VALUE OF COMMONWEALTH MINERAL PRODUCTION IN 1917—*continued.*

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N.T.‡	C'wealth.
	£	£	£	£	£	£	£	£
Gems (unspecified)	..	..	14,208	..	..	..	..	14,208
Gold ..	349,038	857,500	761,639	30,334	4,121,645	61,577	3,677	6,185,410
Gypsum ..	..	1,335	..	11,179	..	..	..	12,514
Iron (pig) ..	247,637	..	..	..	..	..	..	247,637
Iron oxide ..	1,265	..	..	..	..	..	..	1,265
Ironstone ..	3,498	..	23,611	359,723	..	..	..	386,832
Kaolin ..	2,032	1,500	..	3,442	..	..	..	6,974
Lead and silver-lead ..	616,531	..	14,407	..	139,940	†	..	770,878
Lead and silver-lead ore, concentrates; &c.	4,165,324	..	*	12,018	593	152,122	275	4,330,332
Limestone flux ..	25,746	..	56,926	21,395	..	..	..	104,067
Magnesite ..	9,992	222	..	300	50	..	..	10,564
Manganese ore ..	2,791	..	105	1,597	..	..	..	4,493
Mica ..	..	..	..	337	..	..	..	337
Molybdenite ..	31,608	500	48,618	359	158	..	45	81,288
Opal ..	12,522	..	100	500	..	..	..	13,122
Phosphate ..	4,500	1,525	..	6,064	..	..	..	12,089
Platinum ..	2,072	..	..	..	..	..	..	2,072
Pyritic ore ..	..	..	..	..	1,752	7,137	..	8,889
Salt ..	..	†	..	93,716	..	..	..	93,716
Scheelite ..	23,419	..	1,523	..	42	12,130	..	37,114
Shale ..	36,565	..	..	..	..	..	..	36,565
Silver ..	328,241	1,406	40,774	333	38,339	..	..	409,093
Tantalite ..	..	..	..	..	2,513	..	..	2,513
Tin (ingot) ..	240,410	..	..	..	..	427,917	..	668,327
Tin ore ..	133,286	19,709	160,600	..	45,288	*	27,120	386,003
Wolfram ..	21,682	3,600	58,548	30	..	28,714	20,269	132,843
Zinc, spelter and concentrates ..	441,486	..	..	..	..	..	..	441,486
Unenumerated ..	49,268	24	3,101	16,707	865	5,132	..	75,097
Total ..	12,554,696	1,294,240	4,012,977	1,460,674	4,629,027	1,582,322	56,903	25,590,839

* Included with metal.

† Not available for publication.

‡ Included with ore.

§ Year ended 30th June, 1917.

It may be pointed out in connection 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 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. Thus, the New South Wales Mines' Report supplies the value of exports only in connection with building stone, and it is obvious that such figures are of little value as regards production, while the Victorian figures are incomplete. It has therefore been considered advisable to discard both totals. By restricting the comparison to items in connection 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 1917 consist of—lime, £40,865; marble, £770; Portland cement, £347,381. Sulphuric acid to the value of £33,084 was produced in New South Wales in 1917. For South Australia the principal items in the unenumerated class are flint pebbles, £3,956; and fireclay, £1,405; while the sulphur contents of the copper ores are valued at £8,820.

4. Total Production to end of 1917.—In the next table will be found the estimated value of the total mineral production in each State up to the end of 1917. The figures given in this table are also exclusive of the same items referred to in connection with the preceding table. Thus the total for New South Wales falls short by £5,812,000 of that published by the State Department of Mines, the principal items excluded being cement, £3,844,000; lime, £489,000; and building stone, £26,000.

COMMONWEALTH MINERAL PRODUCTION TO END OF 1917.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.*	C'wealth.
	£	£	£	£	£	£	£	£
Gold ..	61,998,778	298,651,651	82,111,979	1,541,917	133,888,331	8,674,405	2,256,937	589,123,998
Silver and lead ..	80,501,877	255,538	2,992,821	361,363	1,215,714	6,301,439	61,884	91,693,636
Copper ..	14,292,224	216,656	19,546,341	31,069,636	1,534,626	13,722,318	218,933	80,600,734
Iron ..	2,035,504	15,641	370,371	1,237,673	36,695	52,110	..	3,747,994
Tin ..	10,963,004	836,726	9,155,443	..	1,303,886	13,834,785	413,333	36,507,177
Wolfram ..	222,060	10,302	963,377	301	1,395	104,139	87,288	1,388,862
Zinc ..	12,651,737	..	..	15,993	5,437	22,876	..	12,696,043
Coal ..	87,779,612	3,864,478	7,593,344	..	1,849,237	863,588	..	101,950,259
Other ..	9,849,518	561,176	1,710,366	1,429,965	46,243	205,640	17,751	13,820,659
Total ..	280,294,314	304,412,168	124,444,042	35,059,848	139,881,564	43,781,300	3,056,126	931,529,362

* To 30th June, 1917.

The "other" minerals in New South Wales include antimony, £335,686; bismuth, £152,421; chrome, £106,683; coke, £3,802,630; diamonds, £131,077; opal, £1,426,432; and oil shale, £2,424,769. In the Victorian returns antimony ore was responsible for £486,747. Included in "other" in the Queensland production were opal, £178,295; gems, other, £330,297; antimony ore, £58,343; manganese, £70,041; and limestone flux, £491,432. The chief item in South Australian "other" minerals was salt, £801,911, and limestone flux, £150,741. Considerable values from gypsum and rock phosphates are also included. In the Tasmanian returns limestone flux was responsible for £91,739, 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) METALS.

§ 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 the remark applies to some extent also to the returns for Western Australia and Tasmania.

In New South Wales the yield for 1917 was about 26,000 ozs. lower than in 1916, and was the second lowest recorded since 1851. In Victoria the yield for 1917 shewed a decrease of 54,781 ozs. fine on that for the preceding year. With the exception of the Gippsland district, where there was a small increase, all the gold mining areas shewed a diminished yield as compared with 1916, the falling-off in Bendigo amounting to nearly 26,000 ozs.; in Ararat and Stawell to 15,000 ozs.; and in Maryborough to 12,000 ozs. crude. In Queensland the yield in 1917 was nearly 36,000 ozs. less than in the preceding year. As is 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 1917 shew a decrease of about 600 ozs. on the previous year's output. For Western Australia the figures shew a decrease of over 91,000 ozs. in 1917, as compared

with 1916, diminished returns being recorded in the outputs from all the fields except Peak Hill, Murchison, and Phillips River. For Tasmania there was a decline of about 1,300 oza., due to cessation of operations at some of the mines.

VALUE OF GOLD RAISED IN AUSTRALIA, 1851 TO 1917.

Year.	N.S.W.	Victoria.	Queensland.	S. Aust.	W. Aust.	Tasmania.	Nor. Ter.	C'wealth.
	£	£	£	£	£	£	£	£
1851	468,336	851,596	..	..	..	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	654,591	11,277,152	..	..	..	†	..	11,931,746
1856	689,174	12,217,076	..	..	..	†	..	12,804,150
1857	674,477	11,320,852	..	..	..	†	..	11,996,475
1858	1,104,175	10,384,924	..	..	..	1,146*	..	11,489,949
1859	1,259,127	9,394,812	..	..	..	850	..	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	6,489,788	83,292	..	..	..	..	7,878,006
1865	1,231,243	6,444,216	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	..	6,614,437
1870	931,016	5,217,216	489,539	..	..	3,666	..	7,916,627
1871	1,250,485	5,475,768	619,907	*550,000	..	23,467	..	7,663,758
1872	1,644,117	5,325,508	660,396	6,363	..	27,314	..	6,814,186
1873	1,396,375	4,681,588	717,540	293	..	18,390	..	6,810,923
1874	1,041,614	4,390,572	1,356,071	4,175	..	18,491	..	5,961,152
1875	877,664	4,273,668	1,438,433	7,034	..	11,982	..	6,068,511
1876	613,190	3,855,040	1,438,111	9,888	..	44,923	..	5,050,614
1877	471,448	3,232,160	1,312,265	..	..	23,289	..	4,712,825
1878	430,200	3,032,160	1,149,240	1,225	..	100,000	..	4,760,708
1879	407,219	3,035,788	1,034,216	90	..	230,895	£52,500	4,933,424
1880	444,252	3,316,484	944,869	..	..	201,297	£26,522	5,194,390
1881	573,582	3,339,512	957,570	880	..	216,901	111,945	5,043,521
1882	526,522	3,458,440	785,868	4,634	..	187,337	80,720	4,580,523
1883	458,530	3,121,012	736,810	10,534	..	170,442	77,195	4,826,810
1884	396,059	3,114,472	1,062,471	15,469	..	160,404	77,935	4,626,069
1885	378,665	2,940,872	1,062,514	18,295	..	155,309	70,414	4,428,339
1886	366,294	2,660,874	1,187,189	32,535	1,148	117,250	63,139	4,666,401
1887	394,579	2,471,104	1,481,990	72,003	18,517	158,533	63,775	4,737,256
1888	317,241	2,500,104	1,690,477	34,205	13,273	147,154	34,802	5,552,983
1889	434,784	2,459,352	2,695,629	37,305	58,871	119,703	47,339	5,280,972
1890	460,285	2,354,240	2,182,563	20,808	86,664	75,888	80,524	95,149
1891	559,251	2,305,596	2,030,312	27,380	115,182	145,459	108,763	108,110
1892	575,299	2,617,824	2,164,391	26,997	220,284	158,917	108,763	109,392
1893	651,256	2,684,504	2,167,794	12,561	421,385	141,326	102,734	7,641,491
1894	1,156,717	2,867,816	2,360,282	33,401	787,999	217,924	206,115	81,173
1895	1,315,929	2,960,344	2,150,561	26,600	879,748	206,115	81,173	9,828,597
1896	1,073,360	3,220,348	2,132,979	14,350	1,068,808	237,574	81,024	11,078,456
1897	1,104,315	3,251,064	2,552,668	39,020	2,564,977	296,060	84,467	14,533,084
1898	1,201,743	3,349,028	2,750,348	10,676	3,990,698	291,496	63,459	15,578,145
1899	1,623,320	3,418,000	2,838,446	15,582	6,246,732	327,545	67,694	14,017,508
1900	1,070,920	3,229,628	2,871,578	14,494	6,007,611	316,220	70,251	16,302,731
1901	737,164	3,102,753	2,541,764	16,613	7,235,653	295,176	69,647	15,935,118
1902	681,970	3,062,028	2,720,512	24,828	7,947,961	301,573	70,251	15,711,931
1903	1,080,029	3,259,482	2,839,801	28,650	8,770,719	254,403	69,647	14,626,384
1904	1,146,109	3,252,045	2,714,934	76,025	8,424,226	280,015	21,581	13,514,762
1905	1,165,013	3,173,744	2,517,295	45,853	8,305,654	312,580	23,942	12,611,267
1906	1,078,866	3,280,478	2,313,464	27,000	7,622,749	254,963	48,864	11,557,950
1907	1,050,730	2,954,617	1,978,938	20,540	7,210,749	277,607	39,910	10,551,924
1908	954,854	2,849,838	1,975,554	12,300	6,999,882	242,482	22,671	9,276,573
1909	869,546	2,778,956	1,935,178	30,206	6,776,274	190,201	13,250	8,269,938
1910	892,211	2,422,745	1,874,955	28,000	6,246,848	157,370	9,754	7,075,980
1911	769,353	2,140,855	1,640,323	15,000	5,823,075	132,108	*3,781	6,185,410
1912	702,129	2,039,464	1,477,979	28,000	5,448,385	161,300	**3,677	..
1913	635,703	1,847,476	1,128,768	27,800	5,581,701	141,876	..	..
1914	528,873	1,755,236	1,059,674	26,581	5,237,353	111,475	..	..
1915	562,819	1,397,793	1,060,703	25,830	5,140,228	78,784	..	..
1916	459,370	1,090,194	913,951	33,000	4,508,532	67,072	..	..
1917	349,038	857,500	761,639	30,334	4,121,645	61,577	..	..
Total	61,998,778	298,651,651	82,111,979	1,541,917	133,888,331	8,674,405	2,256,937	589,123,998

* Mines Department estimate of gold production to 1871. † Including gold dust to the value of £3,020 exported in 1850. ‡ Not available. § Estimate prior to 17th August, 1880. ¶ 17th August to 31st December, 1880. ¶ 1st January to 30th June. ** 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, 1906, 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 £4 4s. 11¹/₂d. :-

QUANTITY OF GOLD PRODUCED IN THE COMMONWEALTH, 1908 TO 1917.

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.
1908 ..	224,792	670,909	465,085	2,896	1,647,912	57,085	5,695	3,074,374
1909 ..	204,709	654,222	455,580	7,111	1,595,270	44,777	7,323	2,968,992
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	*890	1,946,908
1916 ..	108,145	256,653	215,162	7,769	1,061,399	15,790	†909	1,665,827
1917 ..	82,170	201,873	179,305	7,141	970,318	14,496	†866	1,456,169

* 1st January to 30th June.

† 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, 1908 TO 1917.

State.	Annual Average of Gold Production, 1908 to 1917.	Percentage on Commonwealth.	State.	Annual Average of Gold Production, 1908 to 1917.	Percentage on Commonwealth.
	£			£	
Commonwealth ..	9,729,617	100·00	New South Wales ..	663,390	6·82
Western Australia ..	5,588,392	57·44	Tasmania ..	134,425	1·38
Victoria ..	1,918,006	19·71	South Australia ..	25,705	0·27
Queensland ..	1,382,872	14·21	Northern Territory	16,827	0·17

4. Methods of Gold Mining adopted in Each State.—(i) *New South Wales.* In New South Wales the earlier "rushes" were to surface alluvial or shallow-sinking grounds. Many of these were apparently soon worked out, but there is reason to believe that in some instances payable results would be obtained by treating the rejected wash-dirt on more scientific principles. With the exhaustion of the surface deposits discoveries were made by sinking to what are called deep alluvial leads, representing the beds of old drainage channels in Pliocene and Pleistocene times. The first of these deep alluvial leads

was discovered at Forbes, in New South Wales, in 1862. The Tertiary deep leads at Gulgong were discovered in 1871. Cretaceous leads occur at Tibooburra, and detrital gold has been found in permo-carboniferous conglomerates at Tallawang. The method of dredging is 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 2,952 ozs. in 1917, the chief yields being—Hill End, 101 ozs.; Windeyer, 224 ozs.; Major's Creek, 140 ozs.; Adelong, 106 ozs.; Sofala, 382 ozs.; Uralla, 223 ozs.; Tumut, 142 ozs.; Tumberumba, 151 ozs. The quantity obtained by dredging was 27,364 ozs.; the largest returns being obtained at Araluen, 8,105 ozs.; Adelong, 11,186 ozs.; Braidwood, 558 ozs.; Gundagai, 6,198 ozs.; Stuart Town, 1,266 ozs. The dredges in operation during 1917 numbered 67, of which 16 were of the bucket type and 51 were suction plants. In the recovery of gold 13 bucket dredges and 3 pumping plants were employed, while 3 bucket dredges and 48 pumping plants were engaged in the winning of stream tin. The value of the plants in operation was estimated at £317,349. The quantity of gold won from quartz amounted to 45,621 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 21,487 ozs. and 1,957 ozs. Next come the Wellington field with 5,324 ozs.; Peak Hill, 2,970 ozs.; Wyalong, 2,500 ozs.; Hill Grove, 2,356 ozs.; Hill End, 2,320 ozs.; and Cootamundra, 1,260 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 1917. 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, 1917.

District.	Alluvial.		Quartz.	Total.
	Other than by Dredging.	By Dredging.		
	Ozs.	Ozs.	Ozs.	Ozs.
Albert	51	..	..	51
Bathurst	409	..	2,111	2,520
Clarence and Richmond	26	..	188	214
Cobar .. .. .	..	..	23,444	23,444
Hunter and Macleay .. .. .	..	..	300	300
Lachlan	135	6,198	4,363	10,696
Mudgee	284	..	8,657	8,941
New England	28	..	54	82
Peel and Uralla	429	..	2,376	2,805
Southern	328	8,663	1,265	10,256
Tambaroora and Turon	606	1,266	2,337	4,209
Tumut and Adelong	656	11,237	526	12,419
Total	2,952	27,364	45,621	75,937

(ii) *Victoria.* Lode mining predominates in Victoria, although a considerable amount of gold is 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 five 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, and Ballarat districts, the number of plants in operation at the end of 1917 being 73, of which 26

were bucket dredges, 16 pumps, 25 jet elevators, and 6 sluicing by gravitation. The total quantity of gold won by dredging and sluicing in 1917 was 44,756 ozs., the total area treated being 306 acres. Tin to the value of £16,936 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, 1917.

District.	Alluvial.	Quartz.	Total.
	Ozs.	Ozs.	Ozs.
Ararat and Stawell	12,665	1,772	14,437
Ballarat	5,792	14,267	20,059
Beechworth	37,239	13,973	51,212
Bendigo	2,114	63,960	66,074
Castlemaine	9,479	29,373	38,852
Gippsland	4,450	3,954	8,404
Maryborough	11,727	1,389	13,116
Total	83,466	128,688	212,154

The largest output from lode mines in 1917 was furnished by the A.I Gaffney's Creek, with 8,114 ozs., followed by the Ajax Central at Daylesford, with 7,880 ozs., and the North British, Tarrengower, 6,599 ozs. Several of the mines in the Bendigo area reached a production bordering on 5,000 ozs. It is hoped that the consolidation of the mines in the "Central area" at Bendigo will result in a more extended treatment of the low-grade ore. Of the deep alluvial mines the Cathcart Central Company, at Ararat, produced 5,824 ozs., and the Langi Logan South, 2,587 ozs., while the Duke and Main Leads in the Maryborough area returned 5,972 ozs. In dredging, Cock's Pioneer, at Beechworth, was the most successful, with 7,290 ozs.

(iii) *Queensland.* Operations in Queensland are at present chiefly confined to reefing, and to the production of gold in connection with the smelting of copper and other ores, the yield from alluvial in 1917 being only 1,611 ozs., while the quantity produced from stone treated was 79,245 ozs.; from copper and other ores 96,600 ozs.; and from old tailings 1,849 ozs.; making a total production of 179,305 ozs., valued at £761,639. The yields from the principal fields are given below :—

GOLD WON IN QUEENSLAND, ALLUVIAL AND QUARTZ, 1917.

District.	Alluvial.	From Stone Treated.	From Copper and other Ores and old Tailings.	Total.
	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
Charters Towers	86	30,565	133	30,784
Gympie	158	33,201	..	33,359
Mount Morgan	43	..	93,538	93,581
Ravenswood	96	1,639	7	1,742
Croydon .. .. .	..	944	547	1,491
Etheridge, Oaks and Woolgar	185	6,309	615	7,109
Cloncurry .. .. .	..	..	2,647	2,647
Gladstone	66	182	686	934
Clermont	112	1,821	..	1,933
Chillagoe .. .. .	..	3,620	6	3,626
Other districts	865	964	270	2,099
Total	1,611	79,245	98,449	179,305

Included in the total alluvial gold from "other" districts is an amount of 460 ozs. from the Palmer field.

(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 areas. The battery and cyanide returns as published in the *Mining Review* shew that the chief producing centres in 1917 were Deloraine, Tarcoola, and Mount Torrens.

(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 or stamp batteries and Huntington mills, or by a combination of both methods. 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, and scheelite is a common accessory mineral. 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, etc., 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 1917 was 970,317 ounces, of which only about 1 per cent. was alluvial. The yields in each district were as shewn below :—

GOLD WON IN WESTERN AUSTRALIA, ALLUVIAL, QUARTZ, ETC., 1917.

Goldfields.	Alluvial.	Dollied and Specimens.	Crushed.	Total.
	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
East Coolgardie	224	1,715	556,044	557,983
East Murchison .. .. .	..	692	32,164	32,856
Mount Margaret	100	798	100,976	101,874
Murchison	175	1,066	81,065	82,306
North Coolgardie	17	100	34,679	34,796
Coolgardie	151	738	9,397	10,286
Phillips River .. .. .	..	..	4,735	4,735
North-east Coolgardie	13	25	5,895	5,933
Yilgarn .. .. .	..	..	78,245	78,245
Broad Arrow	67	2,978	13,474	16,519
Peak Hill	41	..	1,703	1,744
Pilbara	186	29	5,192	5,407
Dundas .. .. .	..	953	17,468	18,419
Yalgoo	131	17	5,665	5,813
West Pilbara	56	3	246	305
Kimberley	82	..	..	82
Other goldfields	5	1	111	117
Total	1,248	9,115	947,057	957,420

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 429, 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 1917 are given below :—

GOLD WON IN TASMANIA, 1917.

District.	Total.	District.	Total.
	Ozs.		Ozs.
Beaconsfield	5,976	Lisle	310
Mathinna	807	Golconda	
Mt. Victoria	200	Lilydale	
Warrentinna		West Coast	7,414
Mt. Cameron	31	Total	14,738
Lefroy			

The total production was valued at £61,577, equal to 14,496 ozs. fine, of which about 5,976 ounces were produced by the Tasmania Gold Mine, at Beaconsfield. During the year 1917, about 7,000 ounces of gold were produced from the ores treated at the reduction works of the Mt. Lyell Mining and Railway Co. Ltd.

(vii) *Northern Territory.* Pine Creek was for some years the chief mining field in the Northern Territory, but operations have for a long period been carried on in a desultory manner, chiefly by Chinese labour. Lately the output has fallen still lower owing to the transference of Chinese gold miners to tin and wolfram mining. It is stated that the field has been unfairly exploited, the rich pockets only having been scooped out without any systematic prospecting. Confidence in the auriferous prospects of the area was also shaken by the failure of various companies, but in the view of the Mines Department the ground has not been properly tested or systematically mined. The metal is also worked at Bridge Creek, Union Reefs, The Shackle, Fletcher's Gully, and Tanami fields.

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. It may be noted, however, that in 1913 nuggets yielding 180 ozs., 50 ozs., and 23 ozs. were obtained at Poseidon in Victoria. In the same State also, and near the spot at Moliagul where the famous "Welcome Stranger," weighing 2,284 ozs., was discovered in 1869, a mass of quartz yielding 94 ozs. of gold was obtained in 1913. A small lump of quartz from a mine at Tallangatta furnished 44 ozs. In an alluvial deposit at Corindhap four nuggets weighing respectively 100, 60, 60, and 30 ozs. were obtained at a depth of 13 feet.

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 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 1908 to 1917. 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, 1908 TO 1917.

Year.	World's Production of Gold.	Gold Produced in Commonwealth.	Percentage of Commonwealth on Total.
	£	£	%
1908	92,237,000	13,062,000	14.16
1909	92,960,000	12,611,000	13.57
1910	93,390,000	11,558,000	12.38
1911	95,097,000	10,552,000	11.10
1912	96,824,000	9,880,000	10.20
1913	93,435,000	9,377,000	10.04
1914	90,043,000	8,729,000	9.69
1915	95,982,000	8,270,000	8.62
1916	93,043,000	7,076,000	7.61
1917	86,714,000	6,185,000	7.13

While the production of gold in the Commonwealth shews a considerable decrease during the nineteen years from 1897 to 1917, the world's total production more than doubled itself 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 1917.

Country.	1897.	1900.	1915.	1916.	1917.
	£	£	£	£	£
United States	11,787,000	16,269,000	20,490,000	18,715,000	16,912,000
Canada	1,240,000	5,742,000	3,900,000	3,952,000	3,138,000
Costa Rica	2,000	31,000	152,000	202,000	200,000
Colombia .. .. .	..	..	1,121,000	1,095,000	977,000
Transvaal	11,654,000	1,481,000	38,628,000	39,490,000	38,306,000
Rhodesia	800	308,000	3,887,000	3,952,000	3,544,000
Gold Coast	85,000	38,000	1,720,000	1,630,000	1,549,000
Madagascar	8,500	142,000	286,000	198,000	195,000
India	1,571,000	1,893,000	2,370,000	2,303,000	2,222,000
Corea	208,000	371,000	765,000	885,000	913,000
Japan	142,000	290,000	1,331,000	1,274,000	1,150,000
Netherlands East Indies	24,000	112,000	555,000	487,000	499,000

The largest increase was recorded in the Transvaal, where the production more than trebled itself in the nineteen years 1897 to 1917.

Amongst countries where important increases took place between 1908 and 1917 may be mentioned Ecuador, where the production in the interval increased from £72,000 to £182,000; Honduras, from £62,000 to £107,000; Congo, from £26,000 to £429,000; Portuguese East Africa, from £15,000 to £38,000; and Philippine Islands, from £38,000 to £297,000.

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 1913 TO 1917.

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
1913 ..	3,570	11,931	3,123	800	13,445	481	175	33,525
1914 ..	3,443	10,398	2,793	375	12,110	402	180	29,701
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

§ 3. Platinum and the Platinoid Metals.

1. **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 chief deposits at present worked in the State are situated at Platina in the Fifield division, near Parkes, and the production in 1917 amounted to 259 ozs., valued at £2,072, while the total production recorded for the period 1894–1917 amounted to 14,073 ozs., valued at £37,509.

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.

(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 four years.

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 production in 1913 amounted to 1,261 ozs., valued at £12,016, in 1914 to 1,019 ozs., valued at £10,076, in 1915 to 247 ozs., valued at £1,581, in 1916 to 222 ozs., valued at £1,899, and in 1917 to 332 ozs., valued at £4,898. A specimen found by a prospector at the Whyte River weighed 2 ozs. 8 dwts. 7 grs. A new and valuable discovery was made in 1917 in a creek between the Mt. Stewart silver mine and the Meredith Range. It is stated that the selling price has occasionally reached as high as £11 per oz., but this extraordinary value was dependent on causes which are not too well known. 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. Besides a steady and increasing use in the manufacture of fountain pens there is at present some demand for iridium and osmiridium in connection with the prevailing fashion in 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. I. to V., 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 1917 :—

PRODUCTION OF SILVER AND LEAD, AUSTRALIA, 1881 TO 1917.

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	11,224	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
1913 ..	4,173,867	2,954	134,121	1,400	82,422	319,997	2,228	4,716,989
1914 ..	3,611,369	2,188	38,640	529	69,512	96,225	545	3,819,008
1915 ..	3,321,101	1,771	34,610	902	63,629	91,689	..*	3,513,702
1916 ..	4,084,623	3,338	50,588	5,173	109,221	153,796	†1,068	4,407,807
1917 ..	5,110,096	1,406	55,181	12,351	178,872	152,122	†275	5,510,303

* 1st January to 30th June.

† Year ended 30th June.

Information regarding the respective quantities and values of the silver and lead included is given hereunder where available.

New South Wales. The figures quoted 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 must 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 value of these metals locally produced, and the value of concentrates exported during the last five years, will shew the estimated total value of the yield from the three metals :—

VALUE OF PRODUCTION FROM SILVER-LEAD MINES OF NEW SOUTH WALES, 1913 TO 1917.

Year.	Value of Silver, Lead, and Spelter produced within the C'wealth.	Value of Concentrates Exported.	Total.
	£	£	£
1913	2,709,867	3,759,691	6,469,558
1914	2,592,322	3,004,248	5,596,570
1915	1,634,717	3,176,434	4,811,151
1916	1,079,290	3,861,018	4,940,308
1917	945,164	5,052,237	5,997,401

The metallic contents represented in the values above were given as—Silver, 9,363,133 ozs.; lead, 150,637 tons; and spelter, 78,729 tons.

As regards silver alone, the following table, which has been prepared on a basis similar to that on which the preceding table was compiled, shews the estimated total quantity and value of that metal yielded by the mines of New South Wales up to the end of 1907 and during the last ten years :—

ESTIMATED QUANTITY AND VALUE OF SILVER YIELDED BY MINES OF NEW SOUTH WALES TO END OF 1917.

Period.	Produced in Australia.		Contained in Concentrates, etc., Exported.		Total Production.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
To the end of 1907	Fine ozs. 109,680,872	£ 17,152,292	Fine ozs. 120,424,691	£ 20,394,602	Fine ozs. 229,425,563	£ 37,546,894
1908	6,484,288	693,034	5,499,381	587,768	11,983,669	1,280,802
1909	3,717,016	382,605	6,867,775	732,563	10,584,791	1,115,168
1910	5,196,323	561,280	7,608,336	843,257	12,804,659	1,404,537
1911	5,731,468	620,578	8,797,677	973,210	14,529,145	1,593,788
1912	5,220,538	641,707	8,293,711	1,036,715	13,514,249	1,678,422
1913	5,908,638	719,249	8,596,251	1,038,714	14,504,889	1,757,963
1914	5,481,286	630,658	7,879,240	820,754	13,360,526	1,451,412
1915	3,081,952	325,210	5,222,927	544,055	8,304,879	869,265
1916	1,962,091	279,592	6,107,280	839,751	8,069,371	1,119,343
1917	1,782,004	323,241	7,581,129	1,389,874	9,363,133	1,178,115
Total	153,566,476	22,334,446	192,878,398	29,201,263	346,444,874	51,535,709

3. Chief Centres of Silver Production.—Broken Hill, in New South Wales, and Zeehan, in Tasmania, are the great centres of silver production in Australasia. The production in Queensland has, however, considerably expanded during the last few years.

(i) *New South Wales.* (a) *Broken Hill.* A description of the silver-bearing area in this district is given in preceding 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 1915 the production was returned as 1,505,000 tons, but the British Junction, North Junction Lead and Block 10 mines were closed throughout the year. During 1916, when the Junction North mine remained closed, the production was returned at 1,020,000 tons, but the value of the output was £4,480,000 as compared with £3,342,000 in 1915. For the year 1917 the production of ore was stated at 1,031,000 tons, and the estimated value of the output £5,148,000.

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 1917.

Mine.	Authorised Capital.	Value of Output to end of 1917.	Dividends and Bonuses Paid to end of 1917.
	£	£	£
Broken Hill Proprietary Co. Ltd.	600,000	*45,768,375	11,287,654
Broken Hill Proprietary Block 14 Co. Ltd. ..	155,000	3,692,392	601,660
British Broken Hill Proprietary Co. Ltd. ..	339,000	3,787,102	652,550
Broken Hill Proprietary Block 10 Co. Ltd. ..	1,000,000	4,553,640	1,382,500
Sulphide Corporation Ltd. (Central Mine) ..	1,050,000	†19,231,310	2,289,375
Broken Hill South Silver Mining Co.	200,000	8,307,746	2,395,848
North Broken Hill Mining Co. Ltd.	600,000	5,555,220	1,678,940
Broken Hill Junction Lead Mining Co.	150,000	1,084,352	85,000
Junction North Broken Hill Mine	375,000	2,182,615	88,793
The Zinc Corporation Ltd. .. ..	||	2,169,427	10,000
Barrier South Ltd.	168,000	151,157	50,000
Totals	4,637,000	†96,483,336	20,522,320

* The value of the ores purchased during the years 1908 to 1914 is not included. † Output understated owing to incomplete returns. ‡ Not available.

(b) *Yerranderie*. The mines on the Yerranderie field in the Southern Mining District produced 174,321 ozs. of silver in 1916, besides 234 ozs. of gold, and 585 tons of lead, the total production being valued at £42,000. Mining operations in this locality are carried on under considerable difficulties owing to the heavy cost of transport, the cost of cartage to and from Camden railway station—£2 5s. per ton—preventing successful exploitation of the lower grade ores.

(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.

(ii) *Tasmania, West Coast*. The production of silver-lead ore in 1917 was 9,576 tons, valued at £152,122, to which the Zeehan Mines contributed 1,885 tons, valued at £35,000. In the Mt. Farrell District the North Mt. Farrell contributed 2,000 tons, valued at £23,000, while the Magnet Mines returned a yield of 3,800 tons, valued at £76,000, and the Round Hill, Mt. Claude, about 800 tons, valued at £10,000. The silver contents of the copper ores treated at the Mt. Lyell works amounted in 1917 to 305,506 ozs.

(iii) *Queensland*. The yield for the chief silver-producing centres in 1917 was as follows:—Charters Towers, silver £1,636, lead £615; Cloncurry, silver £7,804; Etheridge, silver £2,581, lead £3,015; Mt. Morgan, silver £8,522; Herberton, silver £11,242, lead £2,790; Burketown, lead £6,937, silver £1,275; Chillagoe, silver £3,414, lead £488.

(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 and silver-lead ore in 1917 was valued at £12,000.

(v) *Western Australia*. The quantity of silver obtained as a by-product and exported in 1917 was 222,075 ozs., valued at £38,339. In addition, lead and silver-lead to the value of £593, and 4,661 tons of pig lead, valued at £139,940, were exported.

(vi) *Northern Territory*. Silver-lead ores are worked near Pine Creek, and at Mount Shoebridge near Brock's Creek railway station. About 178 tons of ore were shipped during 1916 from McCarthy's lead mine.

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, 1908 TO 1917.

Year	1908.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.
World's production in 1,000 fine ozs.*	212,570	227,291	240,223	254,214	250,979	214,391	171,429	179,754	176,000	167,000

* Add 000 to figures for fine ounces.

Australasia's share in the world's silver production in 1917 was estimated at 3,500,000 ounces, or about 2 per cent. on the total production.

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 1917.

Year	1881.	1891.	1901.	1911.	1912.	1913.	1914.	1915.	1916.	1917.
Pence per standard oz.	51 $\frac{1}{2}$	45 $\frac{1}{2}$	27 $\frac{3}{4}$	24 $\frac{3}{4}$	28 $\frac{1}{2}$	27 $\frac{1}{2}$	25 $\frac{1}{2}$	23 $\frac{1}{2}$	31 $\frac{1}{2}$	40 $\frac{1}{2}$

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 33 $\frac{1}{2}$ d., the highest realised since 1893, when the average stood at 36 $\frac{1}{2}$ d.

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 1913 TO 1917.

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*	†	8,902‡
1913 ..	9,357	..	204	30	132	1,272	16	11,011
1914 ..	8,242	..	130	25	100	491	10	8,998
1915 ..	5,564	..	49	25	70	519	86	6,313
1916 ..	6,461	..	62	25	§244	555	86	7,433
1917 ..	7,619	..	71	..	§328	646	33	8,697

* Including copper miners. † Included in South Australia. ‡ Including copper miners in Tasmania.
§ 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 production in earlier years and for 1913 to 1917 are shewn in the following tables :—

PRODUCTION OF COPPER, AUSTRALIA, 1881 TO 1917.

State.	1881.	1891.	1901.	1908.	1913.	1914.	1915.	1916.	1917.
QUANTITY.									
N.S.W.	Ingot & Matte 4,124	Tons. 2,363	Tons. 6,087	Tons. 8,679	Tons. 9,153	Tons. 5,081	Tons. 2,463	Tons. 5,617	Tons. 6,576
	Ore .. 1	347	645	392	308	1,526	4,510	554	..
Victoria	Ore .. 583	60	..	983	1,221	..	..	..	..
Q'land	Ingot & Matte 331	85	3,087	14,698	23,655	18,436	19,704	19,520	19,062
	Ore .. 35	1,997	..	..	..	..	..	..	..
S. Aust.	Ingot & Matte 3,824	3,592	9,741	5,628	7,161	6,881	7,725	7,279	7,213
	Ore .. 21,638	13,035	1,869	..	..	..	..	..	..
W. Aust.	Ingot & Matte ..	..	880	479	82	183	946	457	535
	Ore	263	2,661	2,503	4,339	3,913	737	650	966
Tasmania	Ingot & Matte ..	..	9,981	8,833	4,569	7,509	7,901	6,305	5,845
	Ore .. ..	..	10,029	1,185	..	3,288	66	97	771
Northern Territory	Ingot & Matte ..	..	..	100	..	..	..	..	..
	Ore .. ..	..	257	483	424	41	528	831*	950†

VALUE.

	£	£	£	£	£	£	£	£	£
N.S.W. ...	267,884	119,195	412,292	502,812	598,733	274,671	234,437	586,127	814,154
Victoria	8,186	216	1,994	2,829	..	..	..	..	..
Q'land ..	19,637	4,084	182,256	882,901	1,660,178	1,118,648	1,423,793	2,265,422	2,208,232
S. Aust.	418,296	235,817	491,617	338,000	488,986	417,437	561,247	822,527	902,495
W. Aust.	..	4,462	110,769	57,091	142,363	38,174	91,169	64,833	85,738
Tasmania	..	..	1,010,037	609,651	375,664	496,041	709,534	886,454	847,754
Nor. Terr.	..	3,619	8,460	7,968	482	4,860	7,000*	8,162†	5,517†
C'wealth	714,003	367,373	2,215,431	2,400,417	3,269,235	2,349,881	3,032,180	4,633,525	4,863,890

* 1st January to 30th June. † Year ended 30th June.

A short account of the discovery of copper in the different States is given in the 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 1917 was £509,916, out of a total for the State of £814,154. During the year the Great Cobar Limited produced 2,694 tons of copper valued at £314,299, the C.S.A. Mines Ltd. in the same division 443 tons valued at £33,276, and the Gladstone Mine 284 tons valued at £35,099. The most important yields from other districts included 680 tons valued at £73,850 from the Mowamba Mines Ltd. at Nymagee, 650 tons valued at £52,000 from Mount Royal Mine, Tottenham, 292 tons valued at £29,200 from the Abercrombie Mines at Burruga, and from the Mount Hope Ltd. 267 tons valued at £26,700.

The Electrolytic Refining and Smelting Company of Australia Limited, established at Port Kembla, produced 5,604 tons of copper, valued at £706,104, from ores won in the State.

(ii) *Queensland*. The yield in this State amounted in 1917 to 19,062 tons, valued at £2,208,232, to which the Cloncurry field contributed 10,189 tons, valued at £1,181,953. Next in order were Mount Morgan with 6,971 tons, valued at £808,636; Gladstone, 744 tons, £83,295; Herberton, 565 tons, £65,577; Chillagoe, 204 tons, £23,664, and Mount Perry, 176 tons, £20,416.

The Cloncurry district—reckoned the richest and most extensive cupriferous area in Australia—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 1917 the production amounted to 7,213 tons, valued at £902,495, the bulk of the production being from the Wallaroo and Moonta Company which employs over 1,900 hands.

(iv) *Western Australia*. The value of copper and ore exported from this State in 1917 was £85,738. According to the returns, the production in the West Pilbara field was 784 tons, valued at £13,406, while the Phillips River field shewed a production of 5,256 tons, valued at £66,868. The Peak Hill district shewed a production of 288 tons, valued at £9,683, and small quantities were produced on the Murchison and Ashburton fields.

(v) *Tasmania*. The quantity of blister copper produced in Tasmania during 1917 was 5,845 tons, valued at £841,583, and of copper and copper ore, 771 tons, valued at £6,171, the bulk of the production being due to the Mount Lyell Mining and Railway Co. Ltd. This Company treated 240,894 tons of ore in 1917, and produced 5,845 tons of blister copper, containing copper, 5,779 tons; silver, 305,506 ozs.; and gold, 7,339 ozs., the whole being valued at £872,406. The employes in 1917 numbered 1,612, of whom 755 were miners, 701 were engaged in the reduction works, and 156 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, Kilgour Creek, and Woolagarang.

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*. No quotations were recorded for the months August, September and October in the London price for 1914, and the average for that year is based on the returns for the remaining nine months.

FLUCTUATION IN VALUE OF COPPER, 1901 AND 1913 TO 1917.

Year.	London Price per Ton Standard Copper.	New York. Price in Cents per lb.	
		*Lake Copper.	Electrolytic Copper.
	£	Cents.	Cents.
1901	66.79	16.55	16.11
1913	68.35	15.69	15.27
1914	61.52	..	13.60
1915	72.53	..	17.28
1916	116.06	..	27.20
1917	124.89	..	27.18

* The term "Lake" copper is used to designate all copper sold in the trade as such, regardless of the process by which it is refined. During the last five months of 1913 sales by the Lake Superior Companies were scattered and irregular.

4. **World's Production of Copper.**—The world's production of copper in 1901, and during the five years 1913–17, is estimated to have been as follows:—

WORLD'S PRODUCTION OF COPPER, 1901 AND 1913 TO 1917.

Year	1901.	1913.	1914.	1915.	1916.	1917.
World's production— (short tons)	583,517	1,104,517	1,018,395	1,206,793	1,552,347	1,559,736

The Australasian production is estimated at about 2½ 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 1913 TO 1917.

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	*	†	8,103‡
1913 ..	2,629	12	3,687	4,000	213	2,162	53	12,756
1914 ..	1,357	..	2,578	3,000	192	2,099	88	9,314
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

* Included with silver miners. † No returns. ‡ 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 table below shows the production in each of the Commonwealth States during the years 1881, 1891, 1901, and 1913 to 1917 :—

TIN PRODUCED IN AUSTRALIA, 1881 TO 1917.

State.	1881.	1891.	1901.	1913.	1914.	1915.	1916.	1917.
QUANTITY.								
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
New South Wales	{ Ingots 5,824	1,454	649	903	650	857	909	1,109
	{ Ore 609	203	11	2,118	1,667	1,331	1,220	963
Victoria ..	{ Ingots 70	..	..	..	..	..	..	..
	{ Ore 20	1,678	77	57	53	96	122	139
Queensland	{ Ingots 479	193	477	†	†	†	†	†
	{ Ore* 2,977	2,043	1,184	3,198	2,085	2,125	1,707	1,177
Western Australia	{ Ingots ..	..	97	..	..	..	..	..
	{ Ore ..	204	507	484	363	429	463	383
Tasmania ..	{ Ingots 4,120	3,236	1,789	2,609	1,784	2,103	2,219	2,637
	{ Ore 4	56	79	†	†	†	†	†
Northern Territory	{ Ore ..	29	80	258	165	558	1147	1270

VALUE.

	£	£	£	£	£	£	£	£
New South Wales ..	568,795	133,963	76,544	421,292	267,130	266,780	306,497	373,696
Victoria ..	7,620	5,092	4,181	6,980	4,955	9,447	12,955	19,709
Queensland ..	193,699	116,857	93,723	343,669	176,197	183,472	181,401	160,600
Western Australia ..	..	10,200	52,102	72,142	35,649	41,391	49,101	45,288
Tasmania ..	375,775	292,990	216,186	531,983	259,300	292,306	350,852	427,917
Northern Territory ..	..	1,870	5,498	25,526	15,200	55,545	114,700	127,120
Total ..	1,145,889	500,502	448,234	1,401,592	758,431	798,941	915,506	1,054,330

* Dressed tin ore, about 70 % tin. † Included with ore. ‡ Included with ingots. § 1st January to 30th June. || 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 1917 being valued at £183,156. In the Tingha division the yield amounted to 600 tons, valued at £90,533, the yield from dredging being estimated at £60,534. The Emmaville division in the New England district shewed a yield of 936 tons, valued at £141,568, of which dredging produced 520 tons, valued at £78,836. In the Wilson's Downfall division, 137 tons, valued at £14,605, were raised. The Glen Innes division, also in the New England district, returned a yield of 138 tons, valued at £22,886. The Ardlethan field, in the Lachlan division, produced ore and concentrates to the value of £62,069.

(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 1917 was obtained by Cock's Pioneer Gold and Tin Co. in the Eldorado district. About £1,300 worth was won in the Toora District, and small yields were recorded from the Beechworth, Mt. Pilot, Chiltern, and Mitta Mitta districts.

(iii) *Queensland.* The chief producing districts in Queensland during 1917 were Herberton, 541 tons, valued at £71,307; Stanthorpe, 214 tons, £30,550; Cooktown, 218 tons, £31,704; Chillagoe, 104 tons, £13,882; and Kangaroo Hills, 70 tons, £9,142. The production of tin was to some extent adversely affected in 1916 by the lack of skilled miners, and also by the high prices offered for several of the other industrial metals, but the phenomenally high prices realised for tin at the close of 1917 has given a fresh impetus to prospecting operations.

(iv) *Western Australia.* The export of tin ore and ingot for the State during 1917 amounted to 383 tons, valued at £45,288. The production from the Greenbushes field amounted to 238 tons, valued at £29,928, and from the Pilbara field 69 tons, valued at £9,264. There was no production from the other fields in 1917.

(v) *Tasmania.* The tin ore raised in 1917 amounted to 2,637 tons, valued at £427,917, as compared with the year 1913, when the production was returned as 4,010 tons, valued at £531,983. The heavy decline was of course due to the paralysis of the tin market occasioned by the war, coupled to some extent with unfavourable weather conditions. The bulk of the production in 1917 came from the North-Eastern Division with 1,250 tons of ore, valued at £211,995. Of the total yield in this division, 631 tons were contributed by the Pioneer and Gladstone districts, 571 tons by the Ringarooma, Derby, and Branxholm districts, and small quantities from Moorina district and Straits Islands. The next highest output was returned from the North-Western Division with 691 tons, to which the celebrated Mt. Bischoff contributed 438 tons, and the Mt. Bischoff Extended, 195 tons. In the Eastern Division, the Avoca mines produced about 202 tons out of a total of 373 tons. The mines in the Western Division produced 250 tons of tin ore in 1917.

(vi) *Northern Territory.* Mount Wells, in the Burrundie district, has yielded a fair output of tin since 1886, and recent developments have proved that the lodes are increasing in size and quality. Copper, silver-lead and tin shows occur abundantly in the district, but little work has been done on them. The recently discovered tin field at Maranboy, about 40 miles east of the Katherine telegraph station, was the largest producer in 1916. It is stated that rapid and systematic development of the ore bodies on this field is greatly retarded by lack of capital. A fairly extensive deposit has been located at Hayes Creek, about 12 miles from Brock's Creek, and only 6 miles from the railway line. Efficient prospecting would probably reveal the existence of other deposits. Two batteries for the treatment of tin ore have been erected by the Government, one at Maranboy, costing £20,163, and one at Hayes Creek, at an expense of £3,294.

3. *World's Production 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, 1913 TO 1917.

1913.	1914.	1915.	1916.	1917.
Tons. 124,890	Tons. 111,506	Tons. 113,319	Tons. 114,108	Tons. 120,790

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

	1915.	1916.	1917.
Malaya ..	46,800 ..	43,900 ..	39,800
Bolivia ..	21,800 ..	21,100 ..	25,800
Banka ..	13,800 ..	14,600 ..	13,200
Siam ..	7,800 (a) ..	7,800 ..	9,000 (a)
Cornwall ..	5,000 ..	4,700 ..	4,100 (a)
Billiton ..	5,800 ..	5,000 (a) ..	5,000 (a)
Nigeria ..	4,600 ..	5,000 ..	6,500
China ..	3,000 (b) ..	3,800 (a) ..	9,100 (b)
Australia ..	2,300 ..	5,000 (a) ..	4,600
South Africa ..	2,100 ..	2,000 ..	1,600

(a) Estimate.

(b) Shipments to Europe and U.S.A.

Based on the results for the last two years, Australia's share of the world's tin production would appear to be about 4 per cent.

4. **Prices of Tin.**—The average price of the metal in the London market for the year 1897 and from 1907 to 1917 was as follows :—

PRICE PER TON OF TIN, 1897 TO 1917.

Year.			Price per Ton.			Year.			Price per Ton.		
			£ s. d.						£ s. d.		
1897	..	..	61	8	0	1912	..	..	209	8	5
1907	..	..	172	12	9	1913	..	..	206	5	7
1908	..	..	133	2	6	1914	..	..	156	12	7*
1909	..	..	134	15	6	1915	..	..	164	4	0
1910	..	..	155	6	2	1916	..	..	182	3	5
1911	..	..	192	7	0	1917	..	..	237	13	1

* Quotations incomplete.

According to *The Mineral Industry* the monthly average in December, 1917, reached the enormous figure of £298 10s. 3d. per ton. The 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.

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 1913 TO 1917.

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
1913	2,362	116	2,102	403	1,947	267	7,197
1914	2,168	65	1,570	217	1,523	186	5,729
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

§ 7. Zinc.

1. **Production of Zinc.**—The production of spelter 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.

Gratifying results have been achieved in the work of the profitable extraction of the zinc contents of the large heaps of accumulated tailings and from the ore raised on the Broken Hill field. The year 1909 witnessed the passing of this problem out of the experimental stage, and the practical solution of the difficulty which had confronted the mining companies for many years. At present not only is the zinc being obtained in a marketable form, but the silver and lead contents are being turned to profitable account. In 1899 the exports of zinc (spelter and concentrates) amounted to 49,879 tons; in 1909 they totalled 373,906 tons, valued at £1,041,280; and in 1917, 113,531 tons,

valued at £441,486, the great bulk of the production being obtained from tailings. The following table shews the production of spelter and concentrates in New South Wales from 1889 to 1917 :—

NEW SOUTH WALES.—PRODUCTION OF ZINC, 1889 TO 1917.

Year.	Quantity of Zinc (Spelter and Concentrates) Produced.	Value.	Year.	Quantity of Zinc (Spelter and Concentrates) Produced.	Value.
	Tons.	£		Tons.	£
1889	97	988	1914	359,310	1,020,711
1891	219	2,622	1915	190,916	1,111,569
1899	49,879	49,207	1916	209,741	961,849
1913	506,661	1,547,987	1917	113,531	441,486

The total quantity of zinc (spelter and concentrates) produced in New South Wales to the end of the year 1917 was 4,199,876 tons, valued at £12,623,515. The metallic zinc contents of the ores and concentrates produced during 1917 was estimated at nearly 79,000 tons.

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 connection 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 1917.

The Tasmanian mineral returns for 1917 included an item of 48 tons of zinc valued at £1,968, but as the metal was produced at the Electrolytic Zinc Co.'s works at Risdon from concentrates sent from Broken Hill, the item has been excluded from the totals shewn herein.

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 £68 19s. 7d. and £71 18s. 6d. per ton respectively. For 1917 the average recorded was £54 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 connection 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. So far 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. III., p. 508). During 1917 the following materials were received at the blast furnace at the Eskbank Iron Works, Lithgow:—Iron ore, 91,927 tons; limestone, 35,377 tons; and coke, 77,871 tons. The output was 45,025 tons of pig iron, and the quantity of steel ingots made 19,667 tons. The iron ore was raised from quarries at Tallawang and Coombing Park.

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 Hummock Hill, a distance of about 36 miles, by the Company's tramway. The ore quarried for the year ending December, 1918, amounted to 267,863 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 capacity of 350 tons each, and a third furnace of 100 tons for the production of foundry iron. The output of pig iron for the year from the one blast furnace and small foundry furnace amounted to 138,873 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 3,000 tons weekly. The actual output of steel ingots during 1918 was 163,990 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 1918 was as follows:—

Rails	69,008 tons
Billets	26,221 "
Fishplates and Splice Bars	11,485 "
Structural Steel	16,468 "
Round and Octagon Steel	13,157 "
Flat Steel.. .. .	5,308 "
Plates	8,414 "
Blooms	8,197 "
Square Steel	909 "
Rods	3,850 "
Total	163,017 tons

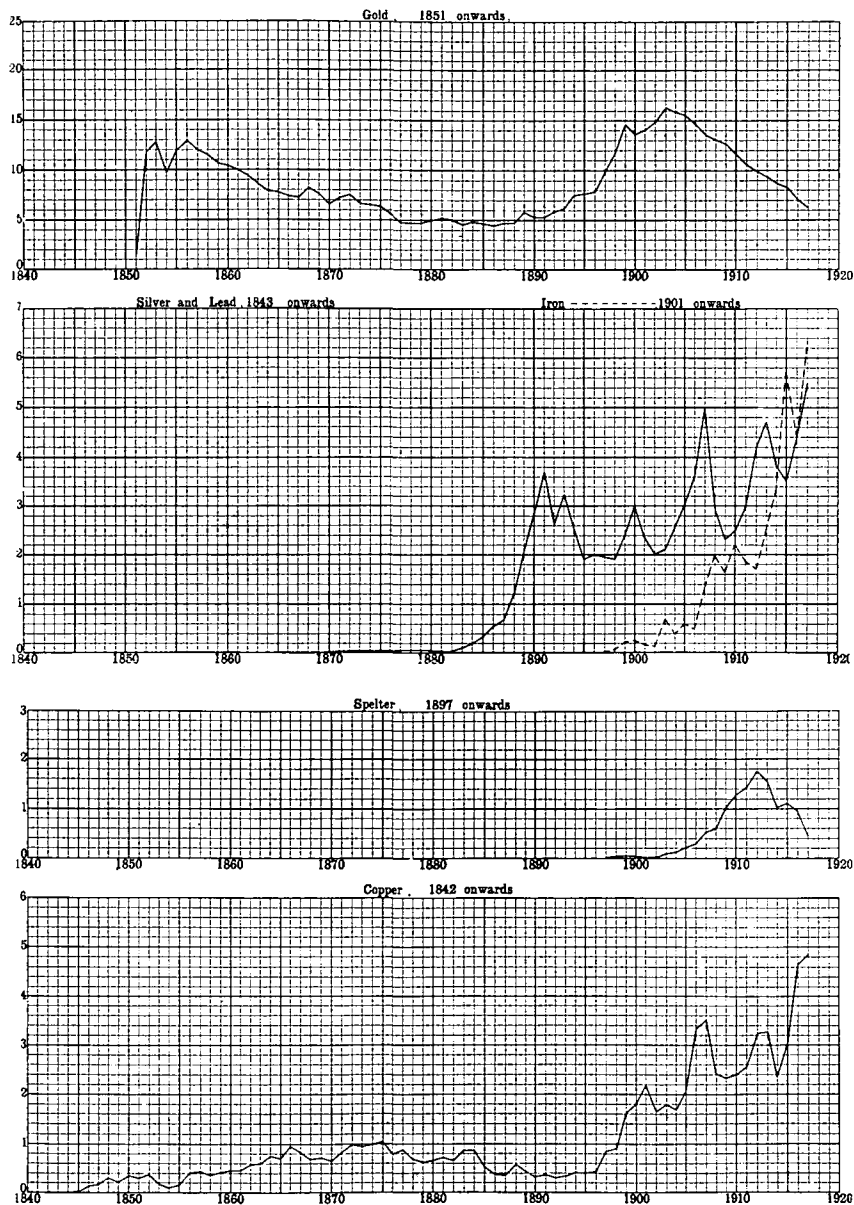
The Company is producing its own coke for the furnaces, having already 156 by-products ovens in operation and 39 in course of construction. The tar and sulphate of ammonia produced during 1918 amounted to 1,587,305 gallons and 2,326 tons respectively.

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

NEW SOUTH WALES.—PRODUCTION OF IRON (LOCAL ORE), 1911 TO 1917.

Particulars.	1911.	1912.	1913.	1914.	1915.	1916.	1917.
Quantity .. Tons	36,354	32,677	46,563	75,150	76,318	52,556	45,025
Value .. £	145,416	130,708	186,252	254,257	267,000	197,085	247,637

GRAPHS SHEWING VALUES OF THE PRINCIPAL MINERALS PRODUCED IN THE COMMONWEALTH, 1840 TO 1917.



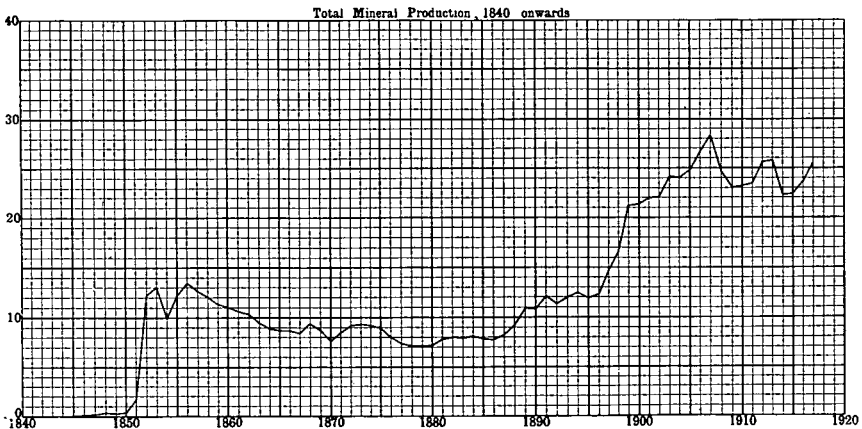
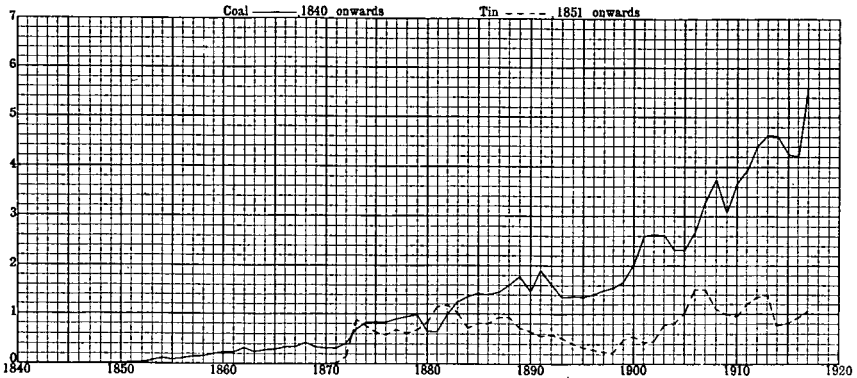
(See pages—for gold, 428 ; silver, 436 ; iron, 446 ; spelter, 445 ; copper, 439.)

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 1842 to 1917.

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.

In the case of the graph for Iron, for " 1901 onwards " read " 1897 onwards."

GRAPHS SHEWING VALUES OF THE PRINCIPAL MINERALS PRODUCED IN THE
COMMONWEALTH, 1840 TO 1917.



(See pages 454 for coal ; 442 for tin ; and 425 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 1917.

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.

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 from Mittagong. During 1917 the iron oxide raised amounted to 1,431 tons, valued at £1,265, while the total output to the end of that year was 26,000 tons, valued £48,000. 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 1917 the quantity raised was 4,482 tons, valued at £3,498. The total raised for the period 1899-1917 amounted to 113,000 tons, valued at £86,000.

(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 in 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 is mined chiefly for fluxing purposes in connection with the reduction of gold and copper ores. During the year 1917, 25,065 tons of ironstone flux, valued at £23,611, were raised, of which 23,438 tons, valued at £22,944, came from the Rockhampton district, and about 1,600 tons, valued at £700, from the Cloncurry field. In 1917 satisfactory tests were made in connection 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 the 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 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 1917 was 328,386 tons, valued at £359,723.

(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 1917 amounted to 3,575 tons, valued at £1,752.

(vi) *Tasmania.* The existence of large quantities of iron ore in Tasmania was noted as far back as 1822, when Surveyor-General Evans alluded to the "surprising abundance of iron within a few miles of Launceston." A company known as the Tasmanian Charcoal Iron Company was formed to work these deposits, and commenced operations in June, 1876. Unfortunately, however, the presence of chromium rendered the pig iron so hard and brittle that the works had to be abandoned. Extensive deposits of specular iron ore are also found in the neighbourhood of the Blythe and Gawler Rivers. The total production of iron ore in 1908 was 3,600 tons, valued at £1,600, and was 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 1917 being 7,685 tons, valued at £7,137.

(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, 1915.* The quantity of iron produced in Australia is but a very small proportion of the world's production, which in 1915, the latest year for which complete estimates are available, amounted to 64,516,000 metric tons (pig iron). The leading position for magnitude of production is held by the United States, which in 1915 produced 30,000,000 tons, compared with Germany's 11,790,000 tons, and the United Kingdom's 8,793,000 tons. The position of the three countries named is similar to what it has been for several years past. Unfortunately, complete returns for a later year than 1911 are not available in regard to steel, but the production for that year is given as 58,276,000 metric tons.

§ 9. Other Metals.

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 and ore) in 1917 amounted to 301 tons, valued at £3,738. The ore was raised mainly in the Hillgrove division, where it is found in association with scheelite and gold, and small quantities were obtained in the Glen Innes and Kempsey Divisions. The total quantity of antimony (metal and ore) raised in New South Wales up to the end of 1917 was 18,262 tons, valued at £335,686. The production of antimony concentrates in Victoria during 1917 amounted to 12,052 tons, valued at £58,489. The whole of the production came from ore raised by a company operating at Costerfield. In Queensland extensive deposits were discovered at Neerdie, in the Wide Bay district, during 1872, also at Wolfram Camp, on the Hodgkinson field, on the Palmer River, in the Ravenswood district, and on the Mitchell River 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. Production in 1916 amounted to 192 tons, valued at £3,965, but owing to the low price quoted for antimony ore the deposits were not worked in 1917. 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.

2. **Arsenic.**—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 in the Stanthorpe District. Operations have been commenced, and it is hoped to produce the article at pre-war prices. The Beescroft mine at Sundown, in the Stanthorpe district, produced 32 tons of arsenical pyrites, valued at £580, during the year, and investigation is being made into the possibilities of other districts. In South Australia attention is being devoted to arsenic-bearing minerals at Woodside, at Westward Ho, near Mannahill, and on Kangaroo Island. 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. **Barium.**—A valuable lode of barium sulphate has been discovered near Dalwin, on the North Lyell railway, in Tasmania. It is stated that the lode is from $2\frac{1}{2}$ to 7 feet wide over a length of over 40 chains.

4. **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. About 20 tons of metal and ore, valued at £9,391, were exported from New South Wales during 1917; the total quantity exported to the end of that year was 633 tons, valued at £152,421. In Queensland wolfram and bismuth have been found in various districts, but the chief centres of production in 1917 were the Herberton and Chillagoe fields. The total production for the year was valued at £80,836, of which 352 tons, valued at £58,367, was returned as wolfram, 4 tons, valued at £1,297, as bismuth, and 131 tons, valued at £21,172, 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. In Tasmania 4 tons, valued at £895, were raised in 1917, principally from the Shepherd and Murphy mine at Middlesex.

5. **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 1917 being 587 tons, valued at £1,468. Nearly four-fifths of the production was obtained as follows :—At Wallendbeen 179 tons, Manilla 148 tons, and 139 tons at Bowling Alley Point. The total production to the end of 1917 amounted to 33,700 tons, valued at £106,683. Chrome iron ore is found in Queensland in the Rockhampton district, where the Black Lode Chrome Quarry, near Canoona, produced 750 tons, and the Elgalla mine, at Cawarral, 10 tons in 1917, the total output being valued at £756.

6. **Carnotite.**—A discovery of carnotite ore was made in 1906 20 miles E.S.E. from the Olary railway station in South Australia. (See also "Radium.")

7. **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 South Australia near Bimbourie and South Blinman; in Western Australia at Norseman and Kanowna; and at various places in Victoria.

8. **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 1917, amounted to 20,817 tons, valued at £616,531. The total lead exported to the end of 1917 was 264,000 tons, valued at £4,821,361. 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 actually produced in 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 1917 amounting to 480 tons, valued at £14,407, of which 231 tons were produced in the Burketown district, 100 tons at Etheridge, and 93 tons were recorded from the Herberton area. Pig lead to the value of £139,940 was exported from Western Australia in 1917. Complete information is not available as to the lead contents of Tasmanian silver-lead ores. 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.

9. **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 Ewengar in the Drake division. The mercury produced was valued at £180. There was no production recorded in 1917. 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 it is also found in New Guinea.

10. **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 1917, 3,721 tons, valued at £2,791, were raised at Grenfell, and about 50 tons were produced from a mineral lease in the county of Forbes. In Queensland there are extensive deposits at Mount Miller,

near Gladstone, and in the Stanthorpe district, the production in 1917 being 21 tons, valued at £105, produced in the former area. 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 have also been noted at Kangaroo Island, Quorn, Tumbly, and various other parts of the State. The production in 1917 was valued at £1,597. In Western Australia ores of the metal are found widely scattered, the black oxide being especially plentiful in the Kimberley district.

11. **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 export in 1917 being 70 tons, valued at £31,608, as compared with 54 tons, valued at £22,066, in the previous year. The production at Kingsgate was valued at about £4,500. In the Deepwater division £18,000 worth was obtained. A small quantity was also obtained in the Tenterfield division. The Whipstick mines produced 20 tons of concentrates, valued at £9,000. There was a small production also from Yetholme in the Bathurst division. In Victoria the Everton Molybdenite Co. at Everton produced in 1917 50 tons of ore, valued at £500. The production in Queensland for 1917 was 111 tons, valued at £48,618, practically the whole of which was contributed by the mines at Wolfram, in the Chillagoe field. A small quantity was produced in 1914 from 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. About £350 worth was obtained in 1917. Molybdenite occurs in small quantities at various localities in Western Australia. In the Northern Territory, molybdenite is found at Yenberrie, where it is stated that the ore increases in richness as the workings become deeper.

12. **Radium.**—(i) It is reported that there have been several definite discoveries in Australia of the occurrence of minerals containing radium. The discovery at Olary, in South Australia, of carnotite, which is an alteration product of pitchblende, the compound from which radium is obtained, has already been referred to. 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 during the last few years, 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.

(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 is estimated by the chemist in charge that the present plant at the works is 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, is at present inactive in consequence of the war.

13. **Tungsten.**—Wolfram and scheelite, the principal ores of tungsten, are both mined to some extent in New South Wales. During 1917 the production of wolfram was 118 tons, valued at £21,682, and of scheelite 127 tons, valued at £23,419. Wolfram was mined chiefly at Torrington, in the Deepwater division, and scheelite at Hillgrove. In Victoria the production of wolfram was returned in 1917 as 22½ tons, valued at £3,600, practically the whole of which came from the Mount Murphy Co. at Benambra. In Queensland, tungsten ores are found in several districts, the chief centres of production in 1917 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 £20,269 was obtained in 1916-17 chiefly from the Burns Wolfram mine, 40 miles east of Pine Creek, from Yenberrie in the same district, and from Hatches Creek about 800 miles south-east of Darwin. Deposits have also been located at Wauchope Creek, 80 miles west of Hatches Creek. Numerous samples of good wolfram ore have been obtained at the Frew River in Central Australia.

In Western Australia a deposit of wolfram was discovered in the West Kimberley district about 70 miles to the north-east of Derby. The export in 1916 was, however, trifling, and there was no record of production in 1917. Wolfram is mined at various points in Tasmania, the production for 1917 being 172 tons, valued at £28,714, obtained chiefly at Avoca 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 in 1917, 69 tons of concentrates of an estimated value of £12,130 were produced.

14. **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. Small quantities of the mineral are also found in the Northern Territory.

15. **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. III., pp. 515-6.)

(ii) *New South Wales.* The production in 1917 amounted to 8,292,867 tons, valued at £4,422,740, or an increase of about 166,000 tons in quantity, and £1,086,000 in value, as compared with the output in 1916. The increased output was yielded by the mines in the Western and Northern districts, the Southern Collieries shewing a small reduction on the 1916 returns.

(iii) *Victoria.* During 1917, 505,364 tons of coal were raised, valued at £345,830. Of this total 405,498 tons, valued at £283,848, were raised by the State coal mine at Wonthaggi, and 34,936 tons, valued at £9,607, from the State brown coal mine at Morwell. The total production for 1917 was about 85,000 tons more than in the preceding year.

(iv) *Queensland.* The quantity of coal raised in 1917 was 1,048,473 tons, valued at £597,360, this production being greater than in 1915 and 1916. The increase is chiefly due to greater production from the collieries in the Ipswich district. Twenty-five collieries were working in the Ipswich district, six on the Darling Downs, four in the Maryborough district, one at Mount Mulligan in the Chillagoe district, and six at Blair Athol and Bluff.

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.* Five collieries were in operation on the Collie field during 1917, and the output for the year was 326,550 tons, or about 25,000 tons more than in 1916.

(vi) *Tasmania.* The principal collieries in Tasmania are the Cornwall and Mount Nicholas, the former producing 23,000 and the latter 31,000 tons out of a total yield in 1916 of 56,000 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 1917.

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	1,846,375
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
1913	10,414,165	596,896	1,037,944	..	313,818	55,043	12,417,866
1914	10,390,622	620,251	1,053,990	..	319,210	60,794	12,444,867
1915	9,449,008	590,968	1,024,273	..	286,666	64,536	11,415,451
1916	8,127,161	420,098	907,727	..	301,526	55,575	9,812,087
1917	8,292,867	505,864	1,048,473	..	326,550	63,412	10,236,666
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
1913	3,770,375	274,940	403,767	..	153,614	25,367	4,628,063
1914	3,737,761	289,099	416,292	..	148,684	27,853	4,619,689
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	..	101,822	38,673	5,596,425

The Victorian figures for 1917 include about 39,000 tons of brown coal, valued at £10,600, of which 35,000 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" is working the top seam at a depth of 2,384 feet. This mine, however, was idle during the greater part of 1917. 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 1917:—

COAL RAISED IN NEW SOUTH WALES, 1881 TO 1917.

District.	1881.		1901.		1911.		1917.	
	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	5,380,957	3,074,966
Southern..	253,283	115,505	1,544,454	407,196	2,066,621	636,163	1,841,869	920,107
Western ..	163,842	50,473	424,720	102,214	831,337	210,329	1,070,041	427,667
Total ..	1,769,597	603,248	5,968,426	2,178,929	8,691,604	3,167,165	8,292,867	4,422,740

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. VI., 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 connection with a comprehensive scheme for electrical power generation and transmission, as well as for the supply of brown coal for other requirements.

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

PRODUCTION OF COAL IN VICTORIA, 1908 TO 1917.

Year.	State Coal Mine.	Outtrim Howitt Company.	Jumbunna Coal Company.	Coal Creek.	Silkstone Co-operative Company.	Austral Coal.	Other Companies.	Total Production.	Value.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	£
1908	..	47,633	58,552	..	6,967	..	810	113,962	64,778
1909	2,946	44,156	65,945	3,265	..	10,631	1,730	128,673	76,945
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	28,987	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

Included in the total for "other companies" is an amount of 20,149 tons raised by the Powlett North Woolamai, and 2,491 tons raised by the Sunbeam Colliery. The figures also include about 35,000 tons of brown coal raised by the State at Morwell.

(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 these, production will probably languish. During 1917 the Department of Mines raised about 700 tons for experimental purposes. The deposit is situated about 370 miles by rail from Adelaide, and 160 from Port Augusta.

(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 Broadsound district, and at the Bowen River. Amongst other places where the mineral is found may be enumerated Clermont, the Palmer River, Tambo, Winton, Mount Mulligan, and the Flinders River. Boring operations have proved the existence of seams of workable coal for some distance on both sides of the Dawson River. A bituminous coal is yielded by the Ipswich seams, those of the Darling Downs yield a cannel, while anthracite of good quality is furnished by the Dawson River beds.

The quantity and value of coal raised in Queensland at various periods since 1861 were as shewn below :—

PRODUCTION OF COAL IN QUEENSLAND, 1861 TO 1917.

Year ..	..	..	1861.	1871.	1881.	1891.	1901.	1917.
Quantity ..	..	Tons	14,212	17,000	65,612	271,603	539,472	1,048,473
Value..	..	£	9,922	9,407	29,033	128,198	189,877	597,360

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

QUEENSLAND COLLIERIES, 1915, 1916, AND 1917.

Districts.	1915.		1916.		1917.	
	Tons Raised.	Average Value at Pit's Mouth.	Tons Raised.	Average Value at Pit's Mouth.	Tons Raised.	Average Value at Pit's Mouth.
		<i>s. d.</i>		<i>s. d.</i>		<i>s. d.</i>
Ipswich	682,491	7 3	583,692	7 11	728,605	10 8
Darling Downs ..	97,411	8 11	99,511	9 10	97,797	12 9
Wide Bay and Maryborough ..	104,358	11 10	79,726	12 2	72,282	15 10
Rockhampton (central)	6,741	8 6	5,034	9 6	6,410	11 10
Clermont	123,731	7 8	124,483	7 9	132,664	11 5
Mount Mulligan (Chil-lagoe)	9,541	12 7	15,281	13 4	10,715	15 6
Total	1,024,273	8 0	907,727	8 7	1,048,473	11 5

It is estimated that about one-third of the production from Ipswich was shipped at Brisbane, about 60 per cent. being for bunker purposes and the remainder going to northern ports for railways, gasworks, meatworks, etc. The high average value of Queensland coal in 1917 was due to a readjustment of coal prices and wages.

(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. The increased output up to 1914 is partly due to the establishment of a bunkering trade at Bunbury and Fremantle, and partly to the employment of improved machinery. Difficulties with an inflow of water on the Scottish Collieries and a falling-off in the bunkering trade were responsible for the diminished returns in 1915. The production from this field since 1901 was as follows :—

PRODUCTION OF COAL IN WESTERN AUSTRALIA, 1901 TO 1917.

Year ..	1901.	1910.	1911.	1913.	1914.	1915.	1916.	1917.
Quantity Tons	117,836	262,166	249,899	313,818	319,210	286,666	301,526	326,550
Value £	68,561	113,699	111,154	153,614	148,684	137,859	147,823	191,822

(vi) *Tasmania.* In Tasmania coal occurs in the following geological periods :—
 (1) Permo-Carboniferous : Lower Coal Measures. (2) Mesozoic : Upper Coal Measures.
 (3) Tertiary : Brown Coal and Lignite deposits. Permo-Carboniferous coal is found at Avoca, Mt. Nicholas and Fingal, Thomson's Marshes, Langloh, Seymour, York Plains, Mike Howe's Marsh, Longford, Colebrook, Schouten Island, Spring Bay and Prosser's Plains, Compton and Old Beach, Lawrenny, Longhole, Sandfly, Ida Bay, Hastings and Southport, Recherché and South Coast, Tasman's Peninsula. Deposits of lignite and brown coal are plentiful in beds of Tertiary age, but they have not been exploited to any extent. An estimate gives the approximate quantity of coal available as sixty-five

million tons, of which eleven millions are in the Lower Coal Measures and fifty-four millions in the Upper Measures, exclusive of an unknown quantity in strata fringing the Central Tiers.

PRODUCTION OF COAL IN TASMANIA, 1901 TO 1917.

District.	1901.	1910.	1911.	1913.	1914.	1915.	1916.	1917.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
North-western ..	2,952	1,720	1,496	1,167	1,074	270	673	350
North-eastern ..	37,239	71,115	54,296	52,759	58,743	63,507	54,284	61,910
Midland ..	1,536	721	635	847	847	691	598	399
South-eastern ..	..	8,899	640	270	130	68	20	753
South-western ..	3,711							
Total ..	45,438	82,455	57,067	55,043	60,794	64,536	55,575	63,412

The bulk of the output in 1917 was raised from the Cornwall and Mt. Nicholas mines in the North-eastern Division, which produced 27,681 and 32,113 tons respectively.

3. Production of Coal in Various Countries.—The total known coal production of the world in 1912 amounted to about 1,100 million tons (exclusive of brown coal or lignite), towards which the Commonwealth contributed 11 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 1911 to 1916 where the returns are available :—

COAL PRODUCTION, BRITISH EMPIRE, 1901 AND 1911 TO 1916.

Year.	United Kingdom.	British India.	Canada.	Australian C'wealth.	New Zealand.	Union of S. Africa.
1901	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.
1911	219,047	6,636	5,791	6,881	1,228	712
1912	271,892	12,716	11,908	10,550	2,066	6,933
1913	260,416	14,706	15,237	11,730	2,178	7,248
1914	287,430	14,708	13,404	12,418	1,888	7,858
1915	265,665	16,446	12,176	12,445	2,276	7,570
1916	253,206	17,104	11,800	11,415	2,209	7,394
1916	256,375	17,254	12,882	9,812	2,257	8,935

COAL PRODUCTION, FOREIGN COUNTRIES, 1901 AND 1911 TO 1916.

Year.	Russian Empire.	Sweden.	German Empire.	Belgium.	France.	Spain.	Japan.	United States.
1901	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.	1,000 tons.
1911	16,215	268	106,795	21,856	31,126	2,609	8,885	240,780
1912	28,414	355	172,065	22,603	38,602	3,853	17,632	447,854
1913	30,640	360	174,875	22,972	40,648	3,626	19,640	443,188
1914	32,206	364	190,109	22,858	40,192	4,293	21,316	477,202
1915	33,113	367	161,535	..	29,311	3,600	19,372	508,893
1916 .. ..	..	412	159,000	14,015	19,590	3,722	22,293	474,660
1916 .. ..	..	415	144,354	..	21,132	4,277	22,534	526,873

The United States returns include a large proportion of anthracite, the quantity averaging for the last five years about 79 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 1917 was 488,417 tons, valued at £349,504, of which amount 487,647 tons, valued at £348,735, were exported from New South Wales. Owing to 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 1917.

Year	1881.	1891.	1901.	1911.	1913.	1914.	1915.	1916.	1917.
Quantity, 1,000 tons ..	1,030	2,514	3,471	5,024	6,232	5,868	4,668	3,434	3,264
Value, £1,000	417	1,307	1,682	2,664	3,342	3,159	2,485	1,873	2,381

The principal oversea countries to which coal was exported from New South Wales during the year 1917-18 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, 1917-18.

Country.	Quantity.	Value.	Country.	Quantity.	Value.
	Tons.	£		Tons.	£
Chile	4,295	2,779	Java	11,953	8,133
Society Islands ..	13,952	10,464	Papua	3,246	2,407
Straits Settlements	11,819	8,595	New Caledonia ..	22,280	17,236
Fiji	45,616	33,824	Gilbert and Ellice		
New Zealand	198,563	143,148	Islands	2,105	1,521
Hawaii	763	572	Solomon Islands	2,871	2,468
India	21,023	16,043	Pleasant Island ..	1,140	756

The quantity of bunker coal taken from New South Wales by oversea vessels was about 495,000 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 include coal shipped as bunker coal :—

DISTRIBUTION OF TOTAL OUTPUT OF NEW SOUTH WALES COAL, 1913 TO 1917.

Year.	Exports to Australasian Ports.	Exports to other Ports.	Local Consumption.	Total.
	Tons.	Tons.	Tons.	Tons.
1913	3,465,787	2,765,937	4,182,441	10,414,165
1914	2,581,810	3,286,223	4,522,589	10,390,622
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

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, 1913 TO 1917.

Year.	Quantity of Coal Consumed.		
	Home Produce.	Produce of Other Countries.	Total.
	Tons.	Tons.	Tons.
1913	8,671,491	4,449	8,675,940
1914	8,944,867	23,066	8,967,933
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

The bunker coal taken away in 1917 is estimated at 763,000 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. 3d., while in 1917 the price advanced to 10s. 8d. per ton, the highest recorded since 1879. 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, 1913 TO 1917.

Year.	Northern District.	Southern District.	Western District.
	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
1913	7 9.91	6 1.13	5 1.85
1914	7 8.26	6 4.12	5 6.33
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

(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. per ton. These averages are exclusive of brown coal, the production of which in 1917 was valued at 5s. 5d. per ton.

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

PRICE OF COAL, QUEENSLAND, 1913 TO 1917.

District.	Value at Pit's Mouth.				
	1913.	1914.	1915.	1916.	1917.
	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>
Ipswich	7 0½	7 1	7 3	7 11	10 8
Darling Downs	8 6	8 9	8 11	9 10	12 9
Wide Bay and Maryborough	10 11	11 4	11 10	12 2	15 10
Rockhampton	10 4	8 9	8 6	9 6	11 10
Clermont	7 7	8 5	7 8	7 9	11 5
Mount Mulligan (Chillagoe)	..	17 2	12 7	13 4	15 6

As previously stated, the readjustment of prices and wages in the industry was responsible for the high averages in 1917.

(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 prices 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.; and in 1917, 11s. 9d. 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.; and in 1917, 12s. 2d. per ton.

7. *Price of Coal in other Countries.*—According to a report published by the Board of Trade, the average value of coal at the pit's mouth in the five principal coal-producing countries of the world, excluding Russia, for which no information is available, for the five years ended 1912, was as follows:—

PRICE OF FOREIGN COAL, 1908 TO 1912.

Year.	United Kingdom.	Germany.	France.	Belgium.	United States.
	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>
1908	8 11	10 3½	12 11½	13 1½	5 11½
1909	8 0½	10 2½	12 5½	11 8½	5 7½
1910	8 2½	9 11½	12 3½	11 10½	5 10½
1911	8 1½	9 9½	12 5½	12 0	5 10½
1912	9 0½	10 6½	12 8½	13 5½	6 1

The price of coal at the pit's mouth in the principal British possessions is averaged by the same authority as follows:—

PRICE OF COAL, BRITISH POSSESSIONS, 1908 TO 1912.

Year.	British India.	C'wealth of Australia.	New Zealand.	Canada.	Union of Sth. Africa.
	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>	Per ton. <i>s. d.</i>
1908	5 3	7 4½	10 4½	10 8	6 9½
1909	4 8½	7 6½	10 10½	10 10½	6 3½
1910	4 1	7 6½	11 1½	11 0½	5 10½
1911	3 11½	7 5½	10 10½	10 9½	5 8½
1912	4 6	7 6½	10 11½	11 5½	5 6½

8. **Employment and Accidents in Coal Mining.**—The number of persons employed in coal mining in each of the States during the year 1917 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 1.17, 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, 1917.

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	17,338	24	148	1.38	8.54	346,000	56,000
Victoria ..	1,557	3	24	1.93	15.41	168,000	21,000
Queensland ..	2,229	4	17	1.79	7.63	262,000	62,000
Western Australia	571	..	121	..	211.91	..	2,700
Tasmania ..	173	..	5	..	28.90	..	12,700
Commonwealth ..	21,868	31	315	1.42	14.40	330,000	32,500

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 1917-18, 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, 1913 TO 1917.

Year	1913.	1914.	1915.	1916.	1917.
Quantity tons	298,612	304,800	417,753	437,587	455,587
Value, total £	208,989	213,069	313,241	387,571	541,093
Value per ton	14s. 0d.	13s. 11d.	15s. 0d.	17s. 9d.	23s. 9d.

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 1917 being 13,399 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, 1913 TO 1917.

Year	1913.	1914.	1915.	1916.	1917.
Manufactured locally tons	14,942	16,685	17,085	17,904	13,399

It is estimated that the total amount of coke consumed for smelting purposes in Queensland during 1917 was 73,000 tons, of which 13,000 tons were produced locally, and 60,000 tons were imported from New South Wales. Oversea imports and exports of coke amounted to a few tons only.

§ 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, cannell, 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 1917 amounted to 31,661 tons, valued at £36,565, as compared with 17,425 tons, valued at £17,772, in 1916. For 1917 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. At the end of 1917 the bore had reached a depth of 2,875 feet, and the casing was within 160 feet of the bottom. Although it is hoped that eventually the bore will be a producer of oil, attention is being devoted to the possibilities of the profitable utilisation of the natural gas therefrom as a source of supply of gasolene. Oil-bearing shales are common in many parts of the State. The deposit at Duinga 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.* In this State large areas of bituminous shale, of which the boundaries are only approximately known, occur at Leigh's Creek and Lake Phillipson. Reference to the mineral known as coorongite is made in sub-section 13. Specimens of bitumen have been discovered on Kangaroo Island, and it was supposed that they were the product of a petroleum-bearing area. The Government Geologist states, however, that the island strata are not of such nature as to support this supposition. In regard to the mainland area it is argued by some investigators that the bores so far put down have not been carried to sufficient depth to fairly test the strata. A bonus of £5,000 for the discovery of oil has been offered by the South Australian Government. An oil expert

engaged by the Government reported adversely on the prospects, but his conclusions have been challenged by other investigators. 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, but there was no record of production in 1917. 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 for many years in the Boroloola district, while several oil licenses have been applied for in the Victoria River district. Results so far, however, have been negative, and experts have pronounced unfavourably on the prospects.

(viii) *Papua.* An expert has reported that the deposits of oil-bearing shale can be worked at a profit, and oil of a satisfactory quality has been obtained from two comparatively shallow bores. It is proposed to test the deeper deposits where indications warrant expectation of a copious supply. (See also Section XXIX., Papua.)

2. *Export of Shale.*—In 1916–17 New South Wales exported a small quantity of shale, but there was no export in the succeeding year.

3. *Shale Oils 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 £309 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.

§ 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 1917, 48,000 tons had been exported, valued at £159,000, the exports for the year 1917 being 1,788 tons, valued at £10,728.

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. 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, however, make no mention of any production during the year.

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 the deposits at Jones' Creek, in the Gundagai division, were opened up during the year 1909 and a trial parcel of 15 tons shipped to Germany. About 10 tons were raised in this division during 1917. Developmental operations were carried on during 1916 by a company at Wood's Reef, in the Barraba division, but there was no record of production. In Queensland seams of asbestos have been found over a belt of country extending from Cawarral to Canoona. Samples of the fibre proved suitable for the manufacture of fibro cement, sheeting, and tiles, but so far a payable deposit has not been located. In Western Australia a deposit of the fibrous chrysolite variety was located at Soanesville, on the Pilbara goldfield, and in 1909 £154 worth of this mineral was raised. The discovery of a deposit of commercial quality was reported from the Nullagine district in 1917. 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, 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 1917 about 318 tons of barytes, valued at £598, were obtained in the Mudgee division, 45 tons were raised in the Braidwood district, and 50 tons, valued at £150, at Harold's Cross, in the Major's Creek area. Deposits of the mineral have also been located in the Burrowa, Carcoar, Trunkey, and Cootamundra divisions. The production in South Australia during 1917 was given as £2,370. About 50 tons of barytes were produced in Tasmania in 1917.

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 1917 amounted to 1,500 tons, valued at £2,000, raised in the Murrumburrah, Pambula, Gulgong, Cootamundra, and Goulburn divisions. Fireclay to the amount of 520 tons was raised in the Lithgow division. Deposits of steatite were worked during 1917 in the Murrumburrah division, the quantity raised during the year amounting to 234 tons. Near Morangaroo 5,000 tons of silica were raised by the Silica Fire Brick Company. About 200 tons of ochre, valued at £220, were raised in the Dubbo division. In Victoria 861 tons of kaolin were obtained at Egerton, 312 tons at Stawell, and 200 tons at Heathcote and Pyalong, the total value of the production being given at £1,500. A small quantity of pigments was raised from a lease in the Balnarring area. In Queensland, 10,602 tons of fireclay, valued at £2,286, were mined during the year 1917 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. Preparations have been made for the manufacture of paints from the chrome and iron oxides at Anderson's Creek, near Beaconsfield.

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, iv.) While the origin of coorongite is still in doubt, it is held by some observers that it is not a petroleum product.

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, but the deposit is not sufficiently pure to prove remunerative. A small quantity was raised during 1917 from a site in the Wilson's Downfall division. 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 in various places at 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. In Western Australia deposits occur at Monglinup Creek, near the Oldfield River, at Northampton, in the Murchison division, on the Donnelly River, and 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.

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, but in spite of the abundant supply of suitable material it has not yet been used for this purpose. In Victoria during 1917 there was a production of 1,187 tons, valued at £1,335, obtained at Boort. Numerous deposits of gypsum are found in Southern Yorke's Peninsula in South Australia. The production in 1917 was valued at £11,179. 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 1917, 3,489 tons, valued at £4,362, were raised at Fifield, and 5,000 tons, valued at £5,000, at Attunga. About 700 tons were raised in the parish of Tout, county of Kennedy. The mineral is found at Heathcote in Victoria, where 74 tons, valued at £222, were produced in 1917. 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 Broken Hill Co. is working a small deposit near the Beetaloo Waterworks. 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, and in 1917 to 42 tons. 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, 110 tons of diatomaceous earth, valued at £350, were produced in 1917. A small quantity also was raised in the Barraba district. In Victoria there is a remarkably pure deposit at Lillicur, near Talbot, while beds of the mineral are also met with at other places in the Loddon Valley, near Ballarat, at various places close to Melbourne, at Craigieburn, Lancefield, Portland, Swan Hill, Bacchus Marsh, etc. During 1917, a production of 750 tons, valued at £2,600, was recorded from Amherst. 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. 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. In Western Australia supplies were obtained from dried-up shallow lakes and consumed locally or exported. The chief centres of production were formerly Rottneest Island, near Fremantle, Middle Island, near Esperance, and Port Gregory; but during recent years the bulk of the demand has been supplied from imports.

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 Kooringa, and also at many other places which have only been prospected to a small extent. The production in 1917 was 5,101 tons, valued at £6,064. Phosphate of lime has been found in small quantities in the limestone caves of New South Wales. In the Wellington division, from the area situated near the caves, about 2,000 tons of phosphate, valued at £4,500, were raised during 1917. There was a small production also from an area in the Cowra division. In Victoria, about 1,500 tons of phosphate rock were raised in 1917 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 Cudgegong field was discovered in 1867, and shortly afterwards the Bingara diamantiferous 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 $28\frac{1}{8}$ carats. It is difficult to secure accurate returns in connection with the production of precious stones, but the yield of diamonds in 1917 was estimated at 2,991 carats, valued at £2,006, while the total production to the end of 1917 is given at 191,855 carats, valued at £131,077. The yield in 1917 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 Echunga goldfield, the most notable gem being Glover's diamond, which was sold for £70.

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. There is no record of production. 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 1917 was valued at £14,208, 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, the sale of the gems recommenced, and as satisfactory prices are being realised the prospects of the field are encouraging. At present there are three regular buyers on the field, and three casual buyers operate occasionally. The approximate value of the stones cut on the field is given as £2,250. About 175 men are engaged in the search for the gems.

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, until recently, contributed the bulk of the production. In 1917, however, out of a total production valued at £12,522, the yield from the Lightning Ridge field, near Walgett, amounted to £11,922, while the output from the White Cliffs field was only £600. The war had a very depressing effect on the industry, and operations were practically at a standstill on the White Cliffs field. 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 £1,426,000.

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 1917 was estimated at £100, and up to the end of that year at about £178,000. 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 1917 amounted to £500.

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 Poonna, 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. The 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 Poonna 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 1917 the number so employed was as follows:—

NUMBER OF PERSONS ENGAGED IN MINING, 1917.

State.	Number of Persons Engaged in Mining for						Total.
	Gold.	Silver, Lead, and Zinc.	Copper.	Tin.	Coal and Shale.	Other.	
New South Wales	1,823	7,619	2,074	1,779	17,338	2,184	32,817
Victoria	6,069	..	..	42	1,557	286	7,954
Queensland	1,375	71	3,154	878	2,229	1,096	8,803
South Australia	150	..	2,000	..	..	650	2,800
Western Australia	8,752	328	154	211	571	25	10,041
Tasmania	155	646	1,671	1,311	173	94	4,050
Northern Territory*	92	33	92	151	..	120†	488
Commonwealth	18,416	8,697	9,145	4,372	21,868	4,455	66,953

* Estimated. † Wolfram.

The following table shews the number of persons engaged in mining in the Commonwealth during each of the years 1891, 1901, and 1916, 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 1917.

State.	1891.		1901.		1917.	
	Miners Employed.	No. per 100,000 of Population.	Miners Employed.	No. per 100,000 of Population.	Miners Employed.	No. per 100,000 of Population.
New South Wales	30,604	2,700	36,615	2,685	32,817	1,753
Victoria	24,649	2,151	28,670	2,381	7,954	566
Queensland	11,627	2,934	13,352	2,664	8,803	1,294
South Australia	2,683	834	7,007	1,931	2,800	648
Western Australia	1,269	2,496	20,895	11,087	10,041	3,254
Tasmania	3,988	2,695	6,923	4,017	4,050	2,036
Northern Territory .. ..	..	..	..	..	488	..
Commonwealth	74,820	2,341	113,462	2,992	66,953	1,366

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, 1917.**—The following table gives particulars of the number of men killed and injured in mining accidents during the year 1917 :—

NUMBERS KILLED AND INJURED IN MINING ACCIDENTS, 1917.

Mining for—	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N. T.	C'wealth.
KILLED.								
Coal and shale	24	3	4	..	..	..	..	31
Copper ..	4	..	2	2	..	1	..	9
Gold ..	..	5	3	..	21	..	1	30
Silver, lead, and zinc ..	7	..	..	..	..	..	..	7
Tin ..	2	..	..	..	..	1	..	3
Other minerals	..	..	..	..	..	..	..	..
Total ..	37	8	9	2	21	2	1	80
INJURED.								
Coal and shale	148	24	17	..	121	5	..	315
Copper ..	3	..	26	6	7	25	..	67
Gold ..	..	17	3	..	701	..	..	721
Silver, lead, and zinc ..	31	..	..	..	4	9	..	44
Tin ..	1	..	2	..	..	9	..	12
Other minerals	2	..	1	..	7	..	..	10
Total ..	185	41	49	6	840	48	..	1,169

§ 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 IV. and V.), 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 1917 the total sum expended in this manner amounted to £479,280, of which £12,000 was advanced in 1917. During the year the Government subsidy to the Miners' Accident Relief Fund amounted to £5,522.

3. **Victoria.**—Under the Mining Development and Surplus Revenue Acts the sum of £489,834 was expended from revenue, and £304,455 was provided out of votes during the period 1897 to 1917 as follows :—

	£
Advances to mining companies	238,185
Advances to prospectors	97,877
Boring for gold and coal	252,117
Construction of roads and tracks	63,211
Erection of testing plants, batteries, etc.	92,430
Miscellaneous, cyanide patents, Schools of Mines, etc.	50,469
Total	794,289

The expenditure in 1917 was £34,000, of which £13,978 was advanced to companies; £4,473 was loaned to miners; £221 was spent on constructing roads, etc.; £10,868 on boring for gold, coal, etc.; and £4,460 on testing plants and miscellaneous. The Government batteries number 33, several of which are managed by local trusts without expense to the Department so far as cost of working is concerned. The State's contribution to the Coal Miners' Accident Relief Fund amounted to £613.

4. **Queensland.**—State assistance to the mining industry in 1917 amounted to £31,597, of which £17,922 consisted of loans in aid of deep sinking; £6,872 grants in aid of prospecting; £2,288 in aid of roads and bridges to gold and mineral fields; £970 advance under *Mining Machinery Advances Act 1906*; and £3,545 purchase of boring plant and boring for oil at Roma.

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 1917 the total amount of subsidy paid was £64,797, of which £10,168 has been repaid, and £1,500 written off, leaving a debit of £53,129. 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 1917 in accordance with the subjoined statement:—Advances in aid of mining work and equipment of mines with machinery, £5,072; advances in aid of erection and equipment of crushing plants, £1,017; rebates to prospectors, £1,571; advances in aid of boring, £129; providing means of transport, £137; subsidies for carting long distances to batteries, £153; Warburton Range Expedition, £731; miscellaneous, £567; making a total of £9,377. The receipts under the Act came to £4,012, of which £2,400 consisted of refunds of advances.

In 1917 there were 32 State batteries in operation. The amount expended thereon up to the end of 1917 was £91,981 from revenue and £274,558 from loan, giving a total of £366,539. During the year receipts amounted to £37,815, and working expenditure to £45,369.

The total value of gold and tin recovered to the end of 1917 at the State plants was £4,918,000, resulting from the treatment of 1,157,407 tons of gold ore and 72,088 tons of tin ore, together with a small amount from residues.

7. **Tasmania.**—Under the terms of the *Aid to Mining Act 1912* the expenditure for the year 1917 amounted to £581, and the total up to the end of that year to £19,480. The bulk of this was expended in mining, prospecting, and development work undertaken by or under the direction of the Department of Mines. Under the *Mining and Public Works Appropriation Act 1913*, a sum of £2,804 was expended during 1917, while the outlay to the end of that year was £57,692. Of the latter sum, £21,273 consisted of advances on the security of ore produced from any mine in the State, and £11,209 was absorbed by expenses in connection with the State Argent Flat mine, Zeehan. Under the *Public Works Appropriation Act 1913*, a sum of £231 was expended in 1917, the total expenditure under this Act being £7,509. Further, a sum of £17,254 was expended under the Mining Appropriation Act of 1915 in respect to the State mine at Zeehan. The practise of granting £5 per month to an approved prospector has resulted in the efficient investigation of mining possibilities over a wide area.

8. **Northern Territory.**—During the year 1917–18 the Government aid to mining amounted to £5,147, of which £2,011 was in aid of prospecting for gold; £2,594, copper; £211, tin; and other, £331.

§ 17. Commonwealth Government Control of Industrial Metals.

1. **General.**—The policy of the Commonwealth Government is to have all metallic ores, as far as possible, treated within the Commonwealth, so that the resultant metals can be marketed in a refined state.

The Australian Metal Exchange, formed in September, 1915, with offices in Melbourne and Sydney, controls the export of metals and minerals (except the noble metals—gold, silver, and platinum), and no metals or minerals can be exported from Australia unless

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the contract be first registered with the Exchange by an active member and, while a state of war lasts, with the consent of the Minister for Trade and Customs. The members of the Exchange must be British companies, British firms, or natural-born British subjects, and the Attorney-General has the right of veto with regard to membership during the continuance of the present war and for one year after the declaration of peace.

2. **Lead.**—The following are the plants existing in the Commonwealth for treating silver-lead ores and concentrate :—

At Port Pirie, South Australia, is situated the Smeltery and Refinery of the Broken Hill Associated Smelters Proprietary Limited. The works were purchased by the above-named company from the Broken Hill Proprietary Co. Ltd. on the 2nd June, 1915, and have since been considerably enlarged and modernised. At present the works have an annual capacity of 160,000 tons of refined lead and 8,000,000 ozs. of silver, and are thus amongst the largest in the world. The Smelter Company, which provides in its Memorandum and Articles of Association for all British control, was formed primarily to treat on a co-operative basis the lead concentrates of its own shareholding companies and to undertake in addition general customs work. In order, however, to give effect to the new metal policy of the Commonwealth Government, arrangements were made about the middle of 1916 whereby other Broken Hill companies, who were not shareholders, were enabled to participate in the advantages of co-operative smelting, refining, and realisation. As a result the whole of the Broken Hill output of lead concentrate, excepting that of the Sulphide Corporation's mine, is to-day controlled and treated by the Associated Smelters Proprietary.

At Cockle Creek, near Newcastle, New South Wales, is located the Smeltery and Refinery of the Sulphide Corporation Ltd. The smelting plant here was established years ago, and produced bullion which was refined in Great Britain. The Refinery was added towards the end of 1917, and is now producing about 50,000 tons of refined lead and also gold and silver. The works cater for all the smaller silver-lead mines in New South Wales, Victoria, Queensland, and Tasmania, as well as for the company's own mine—the Central—at Broken Hill.

At Fremantle, Western Australia, is located the Smeltery and Refinery of the Fremantle Trading Company Limited. The plant running at its full capacity is capable of an annual output of 15,000 tons of pig-lead or silver-lead bullion from usual grade lead concentrates. The company is at present smelting only the Northampton lead ores, which contain little or no silver, and the present output is at the rate of 5,000 tons per annum. The plant in operation has a capacity for an annual output of about 7,000 tons of pig lead.

3. **Zinc.**—The Zinc Producers' Association Proprietary Limited was formed in May, 1916, to control and dispose of the Australian output of zinc concentrate and metals. All the principal zinc-producing companies are members, and the Association is founded on a co-operative basis. Fundamental principles are "all British control" and "equality of treatment" to all members. The Commonwealth Government is represented on the Board, and provision is made in the Articles of Association for the appointment of a representative of the Imperial Government on the Association's London Board.

The following contracts have been negotiated with the Board of Trade, London :—

- (a) Sale of all stocks of Broken Hill zinc concentrate and slime on hand at 31st December, 1917, less certain stipulated reserves, also the sale of 250,000 tons per annum during the period of the war and one year thereafter, and 300,000 tons per annum for nine years succeeding (if these quantities are available) plus option to the buyer over any balance of production. Full provision has been made for the requirements of works in Australia, and for all commitments in respect to contracts already made by the Association to Allied Countries.

- (b) Sale of supplies available up to 45,000 tons per annum of spelter and electrolytic zinc for ten years from 1st January, 1918. The contract contains a provision reserving supplies for Australian consumption and for other existing markets.

In order to facilitate the early establishment of Australian zinc industries the Imperial Government has undertaken to advance £500,000, if required, to finance Australian zinc works, interest on such advances to be at the same rate as is paid by the Imperial Government.

Zinc works have been established within the Commonwealth as follow :—

At Port Pirie, South Australia, there is a Zinc Distillery, established in 1909 by the Broken Hill Proprietary Co. Ltd., and now controlled by the Broken Hill Associated Smelters Proprietary Company Limited. This plant has a capacity for the treatment of 16,000 tons of zinc concentrates and a production of 6,000 tons of spelter and other zinc products. Nearly one-third of the spelter product is used by the Smelter Company in its lead refining.

At Risdon, Hobart, there are works for the production of electrolytic zinc controlled by the Electrolytic Zinc Company of Australasia Proprietary Limited, which, when completed, will have a capacity for a production of about 37,000 tons of electrolytic zinc per annum. The company is also engaging in other allied industries, such as zinc rolling and the manufacture of zinc oxide, lithophone, etc.

A contract for electrical power has been arranged with the Tasmanian Government. The first block of 4,000 h.p. at 11,000 volts is now being delivered to the Risdon works, allowing for an output of 5,000 tons of high-grade zinc per annum. It is expected that the second block of 26,000 h.p. will be delivered in two sections, the first of 11,000 h.p. in about twelve months, and the balance of 15,000 h.p. at a later date, when it is anticipated the plant at Risdon will be ready to treat zinc concentrates and produce high-grade zinc to its full capacity.

The Mount Lyell Mining and Railway Company Limited, having acquired mines on the West Coast of Tasmania containing large bodies of complex sulphide ores, formed a new company—The Mount Read and Rosebery Mines Limited—to take over these properties. The new company promises to be a substantial producer of electrolytic zinc.

4. Copper.—The Copper Producers' Association Proprietary Limited was formed in November, 1917, on similar lines to those of the Zinc Producers' Association, to control and dispose of the output of copper produced within the Commonwealth. All the principal copper-producing companies are members of the Association, and, as in the case of the Zinc Producers' Association, the Commonwealth Government is represented on the Board of Directors.

Works are established within the Commonwealth for the refining of copper as follow :—

At Port Kembla, New South Wales, owned by the Electrolytic Refining and Smelting Company of Australia Limited, with a capacity for an output of 44,000 tons of electrolytic and fire-refined copper per annum.

At Wallaroo, South Australia, owned by the Wallaroo and Moonta Mining and Smelting Company Limited, with a capacity for an output of 9,000 tons of refined copper per annum.

At Bowen, Queensland, owned by the Mount Elliott Limited, with a capacity for an output of 9,000 tons of refined copper per annum.

At Lithgow, New South Wales, owned by the Mouramba Mines Limited, with a capacity for an output of 2,500 tons of refined copper per annum.

At Kandos, New South Wales, works are being erected for the C.S.A. Mines which, when completed, will have a capacity for an output of 2,500 tons of electrolytic copper per annum.

Metal Manufactures Limited, a company formed at the instigation of the Commonwealth Government by the principal copper-producing companies, is now manufacturing at its extensive works at Port Kembla, New South Wales, high conductivity copper wire, rods, bars, and strips. All the usual sections of bar and strip are being made as well as special sections, including commutator segments. Hard and soft-drawn copper wire, and square, hexagonal, and round rods are produced in all sizes. Square and rectangular wire of the dimensions of circular wire is made to order. Stranding machinery has been installed by the company to make hard-drawn bare copper strand of all known sizes. Single and double cotton-covered wires form a regular part of the output.

The extension of the works to cover a wider field of production is now under consideration by the company.

5. Tin.—The principal tin smelters are the Mount Bischoff Company, Tasmania, the Sydney Smelting Company (Pyrmont Works), New South Wales, and the Irvinebank Company, Queensland. These are capable of treating all the tin ore and concentrate at present produced in Australia.

6. Molybdenite, Wolfram, and Scheelite.—The Commonwealth Government in September, 1915, entered into an arrangement with the Imperial Government for the acquisition of all wolfram, molybdenite, etc., produced in Australia. Under this arrangement, practically the whole of these minerals produced in Australia are being acquired for the Imperial Government, the prices fixed from the 1st January, 1918, being—

Wolfram and scheelite, 65 per cent., WO_3 , 52s. 6d. per unit at producing centres.
Molybdenite, 85 per cent., MoS_2 , 100s. per unit at producing centres.

This arrangement with the Imperial Government will terminate six months after the declaration of peace.