

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, etc., have all been found, some in fairly large quantities.

Among the more valuable non-metalliferous substances may be mentioned coke, kerosene shale, graphite, alunite, asbestos, diatomaceous earth, clays, ochres, etc.; in building stones, sandstones, syenites, granites, basalts, augite-andesite, porphyries, serpentines, slates, limestones, and marbles; in precious stones, diamonds, emeralds, rubies, sapphires, amethysts, precious opal, turquoise, topazes, garnets, chrysolites, cairngorm, agates, etc. In general it may be said that the variety of Australian mineral wealth is very great.

3. **Value of Production during 1916.**—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 1916 shewed an advance of over £900,000 on those for the previous year, due principally to the increased return from silver, lead and copper. In Victoria, owing to the decline in the gold yield, the returns for 1916 shewed a decrease in production of about £333,000. The Queensland production shewed an advance of £699,000, due chiefly to increased yield from copper. South Australia shewed an increase of about £212,000, contributed to most largely by copper and gold. For Western Australia the falling-off in 1916 amounted to about £585,000, and was due entirely to the reduced gold yield. The Tasmanian production shewed an increase in 1916 of about £295,000 over the return for the previous year, the improvement being due to the heavier yield from blister copper.

The comparative value of the production of minerals raised in each State during 1916 is given in the following table:—

COMMONWEALTH MINERAL PRODUCTION IN 1916.

Minerals.	N.S.W.	Victoria.	Q'land.	S.A.	W.A.	Tas.	N.T.*	C'wealth.
	£	£	£	£	£	£	£	£
Alunite ...	1,980	...	...	670	...	...	...	2,650.
Antimony ...	13,334	77,275	3,965	...	580	...	...	95,154
Bismuth ...	5,473	...	20,599	...	133	1,059	...	27,264.
Coal ...	3,336,419	216,875	389,348	...	147,823	27,736	...	4,118,201
Coke ...	37,571	...	...	...	...	...	...	387,571
Copper ...	586,127	...	2,265,422	822,527	64,833	886,454	5,517	4,630,880.
Diamonds ...	1,375	...	...	...	...	...	...	1,375.
Gems (unspecified)...	...	...	14,733	...	...	...	...	14,733
Gold ...	459,370	1,090,194	913,951	33,000	4,508,532	67,072	2,554	7,074,673.
Gypsum ...	...	1,853	...	17,825	...	...	...	19,678
Iron ...	197,085	...	...	...	...	...	...	197,085
Iron oxide ...	2,695	...	...	200,107	...	...	...	202,802.
Ironstone flux ...	1,083	...	37,781	275	...	...	...	39,139
Kaolin ...	758	1,200	...	2,616	...	...	...	4,574
Lead (pig, etc.) ...	799,632	...	19,193	...	74,930	...	275	894,030.
Limestone flux ...	20,700	1,689	45,473	23,325	...	...	...	91,687
Manganese ...	1,443	300	2,793	2,700	...	...	...	7,236
Molybdenite ...	22,066	...	34,369	...	...	...	45	56,480.
Opal ...	21,273	...	500	750	...	...	...	22,523.
Platinum ...	687	...	...	...	...	...	...	687
Salt ...	...	†	...	83,000	...	...	...	83,000.
Scheelite ...	13,719	...	...	...	438	...	...	14,157
Shale ...	17,772	...	...	...	...	1,286	...	19,058
Silver ...	349,367	1,239	31,395	514	22,258	...	...	404,773.
Silver-lead ore, concentrates etc. }	2,935,624	...	...	4,659	12,033	153,796	...	3,106,112.
Tin ...	306,497	12,955	181,401	...	49,101	350,852	27,120	927,926.
Wolfram ...	31,163	100	57,812	28	128	16,910	20,269	126,411
Zinc, Spelter and Concentrates ...	961,849	...	...	...	630	...	...	962,479.
Unenumerated ...	38,122	90	1,771	20,404	11,998	15,885	...	88,270
Total ...	10,513,184	1,403,770	4,021,007	1,212,400	4,893,417	1,521,050	55,780	23,620,608.

* Year ended 30th June, 1917.

† Not available for publication.

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 1916 consist of—lime, £38,958; marble, £1625; Portland cement, £420,928; building stone, £65; slates, £861; and grindstones, £121. The South Australian figures are exclusive of flint pebbles, £474. For South Australia the principal items in the unenumerated class are phosphate-rock, £5839; fireclay, £1204; while the sulphur contents of the copper ores are valued at £10,378. Iron pyrites accounted for £13,597 in the total of the unenumerated class in Tasmania.

4. Total Production to end of 1916.—In the next table will be found the estimated value of the total mineral production in each State up to the end of 1916. 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 £4,008,000 of that published by the State Department of Mines, the principal items excluded being cement, £3,496,000; lime, £448,000; and building stone, £26,000.

COMMONWEALTH MINERAL PRODUCTION TO END OF 1916.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	North'n Territory.	C'wealth:
	£	£	£	£	£	£	£	£
Gold ...	61,649,740	297,794,151	79,390,926	1,007,888	129,766,685	7,806,489	2,147,803	579,553,682
Silver and lead ...	75,412,860	226,038	2,503,615	342,199	1,036,558	6,920,455	78,940	86,520,665
Copper ...	13,478,070	218,500	17,421,440	30,036,799	1,449,041	12,724,674	350,975	75,679,589
Tin ...	10,589,308	816,996	8,395,443	...	1,261,569	13,407,043	409,989	35,480,347
Coal ...	83,356,373	3,518,647	6,985,984	...	1,657,415	684,337	...	96,213,256
Other ...	24,659,026	617,532	2,751,594	2,450,007	108,396	296,144	77,149	30,589,848
Total ...	269,145,877	303,191,954	118,079,002	33,836,893	135,279,663	41,839,142	3,064,856	904,437,387

The "other" minerals in New South Wales include antimony, £331,948; bismuth, £143,030; chrome, £102,617; coke, £3,261,537; diamonds, £129,071; iron, £3,018,380; opal, £1,413,910; oil shale, £2,388,205; wolfram, £196,186; and zinc, £12,182,029. In the Victorian returns antimony ore was responsible for £428,258. Included in "other" in the Queensland production were opal, £178,195; gems, other, £300,627; bismuth and wolfram, £1,049,050; antimony ore, £58,343; manganese, £68,512; limestone flux, £432,006; and ironstone flux, £345,014. The chief item in South Australian "other" minerals was salt, £1,075,888, but large values must also be apportioned to limestone flux, the yield from the latter amounting to over £523,000 in the last 10 years. Considerable values from gypsum and rock phosphates are also included. In the Tasmanian returns limestone flux was responsible for nearly £100,000, and iron ore for about £26,000, while the figures for recent years include values for iron pyrites. In the Northern Territory returns wolfram constitutes the chief item in "other" minerals.

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 1916 was about 24,000 ozs. lower than in 1915, and was the lowest recorded since 1889. In Victoria the yield for 1916 shewed a decrease of 72,415 ozs. fine on that for the preceding year. The falling-off was largely due to decreased returns from the Beechworth district, where the total yield in crude ounces was stated as 57,238 in 1916, as against 122,549 in 1915. A fall of nearly 16,000 crude ounces was shewn by the Ballarat district, but the Bendigo returns were over 30,000 ozs. in excess of those for the preceding year. In Queensland the yield in 1916 was nearly 35,000 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. There was an increase of 1688 ozs. in the returns for South Australia for 1916, the yield proving the highest for the last decennium. For Western Australia the figures shew a decrease of nearly 149,000 ozs. in 1916, as compared with.

1915, diminished returns being recorded in the outputs from all the fields except Kimberley and Phillips River. For Tasmania there was a decline of about 2700 ozs., chiefly due to diminished yields at Mathinna and the West Coast.

VALUE OF GOLD RAISED IN AUSTRALIA, 1851 to 1916.

Year.	N.S.W.	Victoria.	Q'sland.	S.A.	W.A.	Tas.	N.T.	C'wealth.
	£	£	£	£	£	£	£	£
1851 ...	468,336	851,596	...	...	...	...	...	1,319,932
1852 ...	2,660,946	9,146,140	...	...	...	...	...	11,807,086
1853 ...	1,781,172	10,976,392	...	...	...	...	...	12,757,564
1854 ...	773,209	8,873,932	...	...	...	...	...	9,647,141
1855 ...	654,594	11,277,152	...	...	...	...	...	11,931,746
1856 ...	689,174	12,214,976	...	8,800	...	...	...	12,912,950
1857 ...	674,477	11,320,852	...	876	...	...	...	11,996,205
1858 ...	1,104,175	10,384,924	...	2,348	...	...	...	11,491,447
1859 ...	1,259,127	9,394,812	...	730	...	...	...	10,654,669
1860 ...	1,465,373	8,896,276	11,631	...	...	...	...	10,373,280
1861 ...	1,806,171	8,140,692	3,137	...	...	...	...	9,950,000
1862 ...	2,467,780	6,920,804	499	12,442	...	...	...	9,401,525
1863 ...	1,796,170	6,779,276	11,820	...	...	...	...	8,587,266
1864 ...	1,804,926	6,489,788	66,513	...	...	...	...	7,861,227
1865 ...	1,231,243	6,446,216	74,216	...	...	...	...	7,751,675
1866 ...	1,116,404	6,187,792	68,325	...	...	...	...	7,372,521
1867 ...	1,053,578	6,005,784	151,125	...	...	4,382	...	7,214,869
1868 ...	994,665	6,739,672	473,956	2,936	...	2,536	...	8,213,765
1869 ...	974,149	6,179,024	417,681	15,593	...	514	...	7,586,961
1870 ...	931,016	5,217,216	390,925	24,217	...	7,475	...	6,570,849
1871 ...	1,250,485	5,475,768	492,635	6,000	...	14,218	...	7,239,106
1872 ...	1,644,177	5,325,508	527,365	6,363	...	16,055	...	7,519,468
1873 ...	1,896,375	4,681,588	572,996	293	...	18,390	...	6,669,642
1874 ...	1,041,614	4,390,572	1,062,899	4,175	...	18,491	...	6,537,751
1875 ...	877,694	4,273,668	1,196,583	7,034	...	11,982	...	6,366,961
1876 ...	613,190	3,855,040	1,140,282	9,888	...	44,923	...	5,663,323
1877 ...	471,448	3,238,612	1,043,790	...	...	23,289	...	4,777,129
1878 ...	430,300	3,032,160	1,149,240	1,225	...	100,000	...	4,712,825
1879 ...	407,219	3,035,788	1,034,216	90	...	230,895	...	4,708,208
1880 ...	444,253	3,316,484	944,869	...	...	201,297	...	4,906,903
1881 ...	573,582	3,333,512	957,570	880	...	216,901	111,945	5,194,390
1882 ...	526,522	3,458,440	785,868	3,080	...	187,337	82,274	5,043,521
1883 ...	458,530	3,121,012	736,810	10,534	...	176,442	77,195	4,580,523
1884 ...	396,059	3,114,473	1,062,471	15,469	...	160,404	77,935	4,826,810
1885 ...	378,665	2,940,872	1,062,514	18,295	...	155,309	70,414	4,626,069
1886 ...	366,294	2,660,784	1,137,189	32,535	1,148	117,250	63,139	4,428,339
1887 ...	394,579	2,471,004	1,481,930	72,003	18,517	158,533	68,774	4,665,400
1888 ...	317,241	2,500,104	1,690,477	34,205	13,273	147,154	34,802	4,737,256
1889 ...	434,784	2,459,352	2,695,629	37,305	58,871	119,703	47,651	5,853,295
1890 ...	460,285	2,354,240	2,182,563	20,808	86,664	75,888	80,769	5,261,217
1891 ...	559,231	2,305,596	2,030,312	27,380	115,182	145,459	98,701	5,281,861
1892 ...	575,299	2,617,824	2,164,391	26,097	226,284	158,917	109,658	5,878,470
1893 ...	651,286	2,684,504	2,167,794	12,661	241,385	141,326	108,130	6,186,986
1894 ...	1,156,717	2,867,816	2,330,282	33,401	787,099	217,024	109,699	7,502,038
1895 ...	1,315,929	2,960,344	2,150,561	26,060	879,748	206,115	102,816	7,641,573
1896 ...	1,073,360	3,320,348	2,132,979	14,350	1,068,808	237,574	81,210	7,828,629
1897 ...	1,104,315	3,251,064	2,552,668	39,020	2,564,977	296,660	81,210	9,889,914
1898 ...	1,201,743	3,349,028	2,750,348	10,676	3,990,698	291,496	84,789	11,678,778
1899 ...	1,623,320	3,418,000	2,838,446	15,582	6,246,732	327,545	63,565	14,533,190
1900 ...	1,070,920	3,229,628	2,871,578	14,494	6,007,610	316,220	67,988	13,578,438
1901 ...	737,164	3,109,753	2,541,764	16,613	7,235,653	295,176	76,609	14,005,732
1902 ...	684,970	3,062,028	2,720,512	24,878	7,947,761	301,573	70,325	14,811,947
1903 ...	1,080,029	3,259,482	2,839,801	26,650	8,770,719	254,403	61,600	16,294,684
1904 ...	1,146,109	3,252,045	2,714,334	39,032	8,424,226	290,015	40,926	15,897,337
1905 ...	1,165,013	3,173,744	2,517,295	29,578	8,305,654	312,380	47,246	15,550,912
1906 ...	1,078,886	3,230,478	2,313,464	47,588	7,622,749	254,963	48,864	14,646,972
1907 ...	1,050,730	2,954,617	1,978,938	24,189	7,210,749	277,607	31,580	13,518,410
1908 ...	954,864	2,849,638	1,975,554	15,148	6,999,582	242,482	38,942	13,061,700
1909 ...	869,546	2,778,956	1,935,173	30,206	6,776,374	190,201	30,906	12,611,267
1910 ...	805,211	2,429,745	1,874,355	28,000	6,246,848	157,370	27,711	11,559,840
1911 ...	769,353	2,140,855	1,640,323	15,000	5,623,075	132,108	26,702	10,547,416
1912 ...	702,129	2,039,464	1,477,979	1,125	5,445,332	161,300	20,150	9,677,407
1913 ...	635,703	1,847,475	1,125,768	27,800	5,581,701	141,876	11,085	9,374,408
1914 ...	523,873	1,755,236	1,059,574	26,581	5,237,353	111,875	10,757	8,729,949
1915 ...	562,819	1,387,793	1,060,703	25,830	5,140,228	78,784	4,182	8,270,339
1916 ...	453,370	1,090,194	913,951	33,000	4,508,532	67,072	2,554	7,074,673
Total £	61,649,740	297,794,151	79,380,926	1,007,888	129,766,685	7,806,489	2,147,803	579,553,682

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 shews 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. 11½d.:—

QUANTITY OF GOLD PRODUCED IN THE COMMONWEALTH, 1907 to 1916.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Nor. Ter.	C'wealth.
	<i>Fine ozs.</i>	<i>Fine ozs.</i>	<i>Fine ozs.</i>	<i>Fine ozs.</i>	<i>Fine ozs.</i>	<i>Fine ozs.</i>	<i>Fine ozs.</i>	<i>Fine ozs.</i>
1907	247,363	695,576	465,881	5,695	1,697,555	65,354	5,031	3,182,504
1908	224,792	670,909	465,085	3,566	1,647,912	57,081	5,636	3,074,985
1909	204,709	654,222	455,580	7,111	1,595,270	44,777	7,276	2,968,945
1910	188,857	570,363	441,402	6,592	1,470,633	37,048	6,524	2,721,419
1911	181,121	504,000	386,165	3,531	1,370,868	31,101	6,286	2,483,072
1912	165,295	480,131	347,946	6,592	1,282,659	37,973	4,744	2,325,340
1913	149,657	434,933	265,735	6,545	1,314,044	33,400	2,610	2,206,924
1914	124,507	413,218	249,468	6,258	1,232,978	26,243	2,532	2,055,204
1915	132,493	329,068	249,711	6,081	1,210,112	18,547	985	1,947,002
1916	108,145	256,653	215,162	7,769	1,061,399	15,790	601	1,665,519

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, 1907 to 1916.

State.	Annual Average of Gold Production, 1907 to 1916.	Percentage on Commonwealth.	State.	Annual Average of Gold Production, 1907 to 1916.	Percentage on Commonwealth.
Commonwealth ...	£ 10,462,541	100.00	New South Wales	£ 733,559	7.01
Western Australia	5,897,303	56.37	Tasmania ...	156,028	1.49
Victoria ...	2,127,717	20.34	South Australia	25,375	0.24
Queensland ...	1,504,602	14.38	North'n Territ'y	17,957	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 Tibbooburra, and detrital gold has been found in permo-carboniferous conglomerates at Tal-lawang. 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 there are now dredges working on practically all the auriferous rivers of New South Wales. 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 3433 ozs. in 1916, the chief yields being—Hill End, 204 ozs.; Windeyer, 366 ozs.; Major's Creek, 123 ozs.; Adelong, 617 ozs.; Sofala, 483 ozs.; Uralla, 183 ozs.; Tuena, 170 ozs.; Tumut, 178 ozs. The quantity obtained by dredging was 19,918 ozs.; the largest returns being obtained at Araluen, 6604 ozs.; Adelong, 6909 ozs.; Braidwood, 433 ozs.; Gundagai, 4255 ozs.; Stuart Town, 1185 ozs.; Tumbarumba, 205 ozs. The dredges in operation during 1916 numbered 68, of which 22 were of the bucket type and 47 were suction plants. In the recovery of gold 15 bucket dredges and 6 pumping plants were employed, while 6 bucket dredges and 41 pumping plants were engaged in the winning of stream tin. The value of the plants in operation was estimated at £338,486. The quantity of gold won from quartz amounted to 58,352 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 7011 ozs. and 20,501 ozs. Next come the Wellington field with 9937 ozs.; Peak Hill, 4002 ozs.; Hill End, 2750 ozs.; Wyalong, 2724 ozs.; Hill Grove, 2700 ozs.; and Cootamundra, 1217 ozs. The Mount Boppy mine in the Cobar district has for some years been the premier gold mine in the State.

The table below shews as far as can be ascertained the yield from alluvial and quartz mining in each of the principal districts during 1916. 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, 1916.

District.	Alluvial.		Quartz.	Total
	Other than by Dredging.	By Dredging.		
	ozs.	ozs.	ozs.	ozs.
Albert	47	...	...	47
Bathurst	527	...	2,218	2,745
Clarence and Richmond	18	...	291	309
Cobar ... ..	...	...	27,512	27,512
Hunter and Macleay ... ..	...	...	475	475
Lachlan	110	4,255	5,076	9,441
Mudgee	489	...	14,237	14,726
New England	37	...	86	123
Peel and Uralla	352	116	2,744	3,212
Southern	278	7,232	1,149	8,659
Tambaroora and Turon	702	1,185	2,960	4,847
Tumut and Adelong	873	7,130	1,604	9,607
Total	3,433	19,918	58,352	81,703

(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 4614 and 4318 feet deep respectively. Altogether there were some four years ago no less than fifty-three shafts in this district which had reached a depth of over 2000 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 1916 being 67, of which 34

were bucket dredges, 21 pump hydraulic sluice, and 12 jet elevator. The total quantity of gold won by dredging and sluicing in 1916 was 48,724 ozs., the total area treated being 344 acres. Tin to the value of £11,712 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, 1916.

District.	Alluvial.	Quartz.	Total.
	Ozs.	Ozs.	Ozs.
Ararat and Stawell	26,061	3,326	29,387
Ballarat	5,660	21,808	27,468
Beechworth	34,785	22,453	57,238
Bendigo	5,001	86,780	91,781
Castlemaine	7,104	36,999	44,103
Gippsland	1,825	6,009	7,834
Maryborough	20,551	4,432	24,983
Total	100,987	181,807	282,794

The largest output from lode mines in 1916 was furnished by the A1 Gaffney's Creek, with 11,851 ozs., followed by the Ajax Central at Daylesford, with 7350 ozs. Of the deep alluvial mines the Cathcart Central Company, at Ararat, produced 16,510 ozs. In dredging, Cock's Pioneer, at Beechworth, was the most successful, with 6706 ozs.

(iii.) *Queensland.* Operations in Queensland are at present chiefly confined to reefing, the yield from alluvial in 1916 being only 2147 ozs., while the quantity produced from stone treated was 103,320 ozs.; from copper and other ores 105,264 ozs.; and from old tailings 4431 ozs.; making a total production of 215,162 ozs., valued at £913,951. The yields from the principal fields are given below:—

GOLD WON IN QUEENSLAND, ALLUVIAL AND QUARTZ, 1916.

District.	Alluvial.	From Stone Treated.	From Copper and other Ores and old Tailings.	Total.
	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
Charters Towers	252	42,154	366	42,772
Gympie	264	38,595	522	39,381
Mount Morgan	68	...	101,455	101,523
Ravenswood	51	5,455	...	5,506
Croydon ... ..	...	2,579	1,260	3,839
Etheridge, Oaks and Woolgar	196	8,637	713	9,546
Cloncurry	19	11	3,390	3,420
Gladstone	84	267	826	1,177
Clermont	289	659	977	1,925
Chillagoe ... ..	...	3,064	48	3,112
Other districts	924	1,899	138	2,961
Total	2,147	103,320	109,695	215,162

(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 1916 were Tarcoola, Wadnaminga, and Deloraine.

(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 the 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 un-oxidised 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 1916 was 1,061,398 ounces, of which only about 0.2 per cent. was alluvial. The yields in each district were as shewn below:—

GOLD WON IN WESTERN AUSTRALIA, ALLUVIAL, QUARTZ, Etc., 1916.

Goldfields.	Alluvial.	Dollied and Specimens.	Crushed.	Total.
	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
East Coolgardie	354	1,790	577,200	579,344
East Murchison	18	898	45,895	46,811
Mount Margaret	51	675	99,886	100,612
Murchison	229	1,324	82,870	84,423
North Coolgardie	38	34	45,075	45,147
Coolgardie	146	840	12,632	13,618
Phillips River ... ..	...	...	5,419	5,419
North-east Coolgardie ... ..	...	91	6,587	6,678
Yilgarn ... ..	...	63	87,931	87,994
Broad Arrow	74	1,989	20,153	22,216
Peak Hill	44	49	2,296	2,389
Pilbara	307	...	5,575	5,882
Dundas ... ..	...	664	20,931	21,595
Yalgoo	9	142	8,044	8,195
West Pilbara	61	...	548	609
Kimberley	162	...	...	162
Other goldfields ... ..	...	...	633	633
Total	1,493	8,559	1,021,675	1,031,727

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 435, which represents mint and export returns.

(vi.) *Tasmania*. The yield from Tasmania in gold mining is chiefly obtained from quartz reefing, although there is a little alluvial mining carried on, as shewn in the table hereunder. As the table shews, however, the bulk of the production of gold is obtained in connection with copper from the West Coast. The yields as returned from each district in 1916 are given below :—

GOLD WON IN TASMANIA, ALLUVIAL AND QUARTZ, 1916.

District.	Quartz.	Alluvial.	Cyanide.	Blister Copper.	Total.
	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.
Beaconsfield ... ..	...	...	4,671	...	4,671
Mathinna	1,663	123	298	...	2,084
Mt. Victoria	323	56	...	...	379
Warrentinna					
Mt. Cameron					
Lefroy ... ..	...	22	...	...	22
Lisle... ..	...	235	...	...	235
Golconda					
Lilydale					
West Coast	10	22	...	8,803	8,835
Total	1,996	458	4,969	8,803	16,226

The total production was valued at £67,072, equal to 15,790 ozs. fine, of which about 4,671 ounces were produced by the Tasmania Gold Mine, at Beaconsfield. During the year 1916, about 9,000 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 being 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 Poseïdon in Victoria. In the same State also, and near the spot at Moliagul where the famous "Welcome Stranger," weighing 2284 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 1907 to 1916. 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, 1907 to 1916.

Year.	World's Production of Gold.	Gold produced in Commonwealth	Percentage of C'wealth on Total.
	£	£	%
1907	84,671,000	13,518,000	15.97
1908	92,274,000	13,062,000	14.16
1909	92,985,000	12,611,000	13.56
1910	93,375,000	11,560,000	12.38
1911	95,083,000	10,547,000	11.09
1912	96,785,000	9,877,000	10.21
1913	92,523,000	9,374,000	10.13
1914	89,812,000	8,730,000	9.72
1915	96,865,000	8,270,000	8.54
1916	94,405,000	7,075,000	7.50

While the production of gold in the Commonwealth shows a considerable decrease during the nineteen years from 1897 to 1916, 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:—

INCREASE IN GOLD YIELD, VARIOUS COUNTRIES, 1897 to 1916.

Country.	1897.	1900.	1914.	1915.	1916.
	£	£	£	£	£
United States ...	11,787,000	16,269,000	19,425,000	20,761,000	19,026,000
Canada ...	1,240,000	5,742,000	3,284,000	3,900,000	3,952,000
Costa Rica ...	2,000	31,000	104,000	152,000	202,000
Colombia ...	...	...	949,000	1,121,000	*
Transvaal ...	11,654,000	1,481,000	35,657,000	38,628,000	39,490,000
Rhodesia ...	800	308,000	3,630,000	3,887,000	3,952,000
Gold Coast ...	85,000	38,000	1,744,000	1,720,000	1,630,000
Madagascar ...	8,500	142,000	222,000	286,000	195,000
India ...	1,571,000	1,893,000	2,338,000	2,370,000	2,303,000
Corea ...	208,000	371,000	680,000	765,000	*
Japan ...	142,000	290,000	1,150,000	1,331,000	*
Netherlands ...	...	...	...	...	...
East Indies ...	24,000	112,000	478,000	*	*

* Not available.

The largest increase was recorded in the Transvaal, where the production more than trebled itself in the eighteen years 1897 to 1916.

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 1912 to 1916.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N. Terr.	C'w'lth.
	No.	No.	No.	No.	No.	No.	No.	No.
1901 ...	12,064	27,387	9,438	1,000	19,771	1,112	200	70,972
1912 ...	3,898	11,856	3,981	920	13,700	485	263	35,103
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	9,563	176	99	20,607

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, but the entire production in 1916 was small, amounting to only 82 ozs., valued at £687, while the total production recorded to the end of 1916 amounted to 13,814 ozs., valued at £35,437.

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 three 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 was as high as £7 10s. per oz., and about 100 men were engaged in the search for it. The quantity produced amounted to 272 ozs., valued at £1888. In 1912 the production was 779 ozs., valued at £5742, or an average of £7 7s. 9d. per oz. The production in 1913 amounted to 1262 ozs., valued at £12,016, in 1914 to 1019 ozs., valued at £10,076, in 1915 to 246 ozs., valued at £1,581, and in 1916 to 222 ozs., valued at £1,899. A specimen found by a prospector at the Whyte River weighed 2 ozs. 8 dwt. 7 gr. It is stated that the selling price has occasionally reached as high as £11 per oz., but this extraordinary value is 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. 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 1916:—

PRODUCTION OF SILVER AND LEAD, AUSTRALIA, 1881 to 1916.

Year.	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tasmania.	North. Terr.	C'wealth.
	£	£	£	£	£	£	£	£
1881	...	5,239	13,494	1,182	11,224	...	...	31,139
1891	3,621,614	6,017	21,879	1,787	250	62,138	4,140	3,717,825
1901	1,954,964	6,550	69,234	3,886	7,718	325,335	...	2,367,687
1912	3,745,796	2,000	121,855	326	41,995	309,098	820	4,221,890
1913	4,173,867	2,074	134,121	1,400	82,422	319,997	2,228	4,716,109
1914	3,611,369	1,540	38,640	529	69,228	96,225	545	3,818,076
1915	3,321,101	1,250	34,610	902	63,629	91,689	1,073	3,514,254
1916	4,084,623	1,239	50,588	5,173	109,221	153,796	275	4,404,915

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,
1912 TO 1916.**

Year.	Value of Silver, Lead, and Spelter produced within the C'wealth.	Value of Concentrates Exported.	Total.
	£	£	
1912	2,477,442	3,692,352	6,169,794
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

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 1906 and during the last ten years:—

**ESTIMATED QUANTITY AND VALUE OF SILVER YIELDED BY MINES OF
NEW SOUTH WALES TO END OF 1916.**

Period.	Produced in Australia.		Contained in Concentrates, etc., Exported.		Total Production.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
To the end of 1906 ...	Fine ozs. 103,079,415	£ 16,356,310	Fine ozs. 114,196,466	£ 19,546,757	Fine ozs. 217,275,881	£ 35,905,067
1907 ...	5,921,457	795,982	6,228,225	845,845	12,149,682	1,641,827
1908 ...	6,484,288	693,034	5,499,381	587,768	11,983,669	1,280,602
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
Total ...	151,784,472	22,006,205	185,297,269	27,811,389	337,081,741	49,817,594

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.

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 1916.

Mine.	Authorised Capital.	Value of Output to end of 1916.	Dividends and Bonuses Paid to end of 1916.
	£	£	£
Broken Hill Proprietary Co. Ltd. ...	600,000	*44,072,310	11,110,503
Broken Hill Proprietary Block 14 Co. Ltd. ...	155,000	3,659,500	588,660
British Broken Hill Proprietary Co. Ltd. ...	339,000	3,447,020	633,800
Broken Hill Proprietary Block 10 Co. Ltd. ...	1,000,000	4,399,873	1,362,500
Sulphide Corporation Ltd. (Central Mine) ...	1,050,000	†18,352,384	2,026,875
Broken Hill South Silver Mining Co. ...	200,000	7,485,495	2,029,208
North Broken Hill Mining Co. Ltd. ...	600,000	†4,985,652	1,438,940
Broken Hill Junction Lead Mining Co. ...	150,000	†1,026,673	85,000
Junction North Broken Hill Mine ...	375,000	†1,929,412	79,793
The Zinc Corporation Ltd. ...	||	1,825,544	10,000
Barrier South Ltd. ...	168,000	151,157	50,000
Totals ...	4,637,000	†91,335,020	19,415,279

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

† Not available.

† Output

(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 1838 ozs. but it rose again in 1916 to nearly 48,000 ozs.

(ii.) *Tasmania, West Coast*. The production of silver-lead ore in 1916 was 11,229 tons, valued at £153,796, to which the Zeehan Mines contributed £48,593. In the Mt. Farrell District the North Mt. Farrell contributed £42,651, while the Magnet Mines returned a yield of £60,660, and the Round Hill, Mt. Claude, £2984. The silver contents of the copper ores treated at the Mt. Lyell works amounted in 1916 to 328,700 ozs.

(iii.) *Queensland*. The yield for the chief silver-producing centres in 1916 was as follows:—Charters Towers, silver £2816, lead £1155; Cloncurry, silver £7664; Etheridge, silver £2817, lead £5901; Mt. Morgan, silver £4911; Herberton, silver £6293, lead £1873; Burketown, lead £9805, silver £1035.

(iv.) *South Australia*. Rich specimens of silver ore have been discovered at Miltalie and Poonana, in the Franklin Harbour district, also at Mount Malvern, 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 1916 was valued at £5000.

(v.) *Western Australia*. The quantity of silver obtained as a by-product and exported in 1916 was 173,012 ozs., valued at £22,258. In addition, lead and silver-lead to the value of £12,033, and 3523 tons of pig lead, valued at £74,930, 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, 1907 to 1916.

Year ...	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	1916.
World's production in 1000 fine ozs.*	183,386	212,570	227,291	240,223	254,214	250,979	214,391	171,429	179,754	177,000

* Add 000 to figures for fine ounces.

Australasia's share in the world's silver production in 1915 was estimated at 4,296,000 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 five years is given below:—

PRICE OF SILVER, 1881 to 1916.

Year ...	1881.	1891.	1901.	1911.	1912.	1913.	1914.	1915.	1916.
Pence per standard oz.	51 $\frac{3}{4}$	45 $\frac{1}{16}$	27 $\frac{3}{16}$	24 $\frac{9}{16}$	28 $\frac{1}{16}$	27 $\frac{9}{16}$	25 $\frac{5}{16}$	23 $\frac{1}{16}$	31 $\frac{5}{16}$

During the month of November, 1906, owing to the small sales in New York, and also to the fact that the Indian, American, and Mexican Governments were all buying silver, the price rose to 33½d., the highest realised since 1893, when the average stood at 36⅞d.

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 1912 to 1916.

Year.	N.S.W.	Victoria.	Q'land.	S Aust.	W. Aust.	Tasmania	N. Terr.	C'wealth.
	No.	No.	No.	No.	No.	No.	No.	No.
1901...	6,298	...	40	150	...	2,414*	†	8,902‡
1912...	9,062	...	208	30	60	1,681	...	11,041
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

* 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 1912 to 1916 are shewn in the following tables :—

PRODUCTION OF COPPER, AUSTRALIA, 1881 to 1916.

State.	1881.	1891.	1901.	1908.	1912.	1913.	1914.	1915.	1916.
QUANTITY.									
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
N.S.W. ... { Copper	*	*	6,087	8,679	8,990	9,153	5,081	2,463	5,617
{ Ore	*	*	645	392	2,044	308	1,526	4,510	554
Victoria... { Copper				983		36			
{ & Ore	*	*							
Q'land ... { Copper	330	85	3,061	14,961	23,120	23,655	18,436	19,704	19,520
S. Aust ... { Copper	3,824	3,551	6,736	6,152	6,295	7,161	6,881	7,725	7,279
{ Ore	21,638	13,239	2,353						
W. Aust.... { Copper	...	...	479	28	82	183	946	457	
{ Ore	...	...	10,157	2,503	9,536	4,339	3,913	737	650
Tasmania ... { Copper	...	...	9,730	8,833	6,528	6,535	7,509	7,901	6,305
{ Ore	...	...	10,029	1,185	...	...	3,288	66	97
Northern Territory	...	...	...	...	377	41	405	1,272	48

* Not available

VALUE.

	£	£	£	£	£	£	£	£	£
New South Wales...	227,667	119,195	412,292	502,812	579,791	598,735	274,671	234,437	586,127
Victoria ...	8,186	216	...	3,928	...	2,829	...	...	...
Queensland ...	19,637	3,554	194,227	893,535	1,698,280	1,660,178	1,118,648	1,428,793	2,265,422
South Australia ...	418,296	235,317	500,077	345,968	461,500	488,986	417,487	561,247	822,527
Western Australia ...	...	4,463	75,246	57,091	59,824	142,513	38,174	91,169	64,833
Tasmania ...	...	...	609,651	...	440,444	375,664	496,041	709,534	886,454
Northern Territory	...	...	...	...	3,998	482	4,860	10,710	5,517
Commonwealth ...	673,786	362,745	2,208,590	2,412,985	3,243,837	3,269,385	2,349,881	3,035,890	4,630,880

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 1916 was £455,240, out of a total for the State of £586,127. At the Great Cobar Mine the Company's smelters resumed operations early in January, and this increased activity, coupled with the high prices ruling for copper in 1916, resulted in the largely increased return as compared with the years 1914 and 1915.

The Cadia Copper mine, at Cadia, in the Orange division, produced 563 tons, valued at £61,932. A yield of 51 tons of matte, valued at £6,281, was obtained from the Grafton Mine at Cangai, the Mount Hope Mine at Mount Hope obtained 110 tons, valued at £8300, and the Mouramba Copper Mines at Nymagee produced 903 tons of copper, valued at £108,807.

The Electrolytic Refining and Smelting Company of Australia Limited, established at Port Kembla, produced 2310 tons of copper, valued at £261,635, from ores won in the State. The English and Australian Copper Co. Ltd., at Waratah, obtained 530 tons, valued at £55,981, from local ores.

(ii.) *Queensland.* The yield in this State amounted in 1916 to 19,520 tons, valued at £2,265,422, to which the Cloncurry field contributed 9908 tons, valued at £1,149,328. Next in order were Mount Morgan with 7646 tons, valued at £886,936; Gladstone 922 tons, £107,010; Herberton, 566 tons, £65,656, and Mount Perry, 175 tons, £20,300.

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 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 1916 the production amounted to 7279 tons, valued at £822,527.

(iv.) *Western Australia.* The value of copper and ore exported from this State in 1916 was £64,833. According to the returns, the production in the West Pilbara field was 949 tons, valued at £16,116, while the Phillips River field shewed a production of 5428 tons, valued at £48,618. The Peak Hill district shewed a production of 251 tons, valued at £8268, and small quantities were produced on the Murchison and Ashburton fields.

(v.) *Tasmania.* The quantity of blister copper produced in Tasmania during 1916 was 6305 tons, valued at £884,689, and of copper and copper ore, 97 tons, valued at £1765, the bulk of the production being due to the Mount Lyell Mining and Railway Co. Ltd. This Company treated 299,414 tons of ore in 1916, and produced 6305 tons of blister copper, containing copper, 6237 tons; silver, 328,700 ozs.; and gold, 8803 ozs., the whole being valued at £940,994. The employees in 1916 numbered 1651, of whom 818 were miners, 671 were engaged in the reduction works, and 162 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 1912 to 1916.

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
1912	72.94	16.56	16.34
1913	68.35	15.69	15.27
1914	61.52	...	13.60
1915	72.53	...	17.28
1916	116.06	...	27.20

* 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 1912-16 is estimated to have been as follows:—

WORLD'S PRODUCTION OF COPPER, 1901 and 1912 to 1916.

Year	...	...	...	...	1901.	1912.	1913.	1914.	1915.	1916.
World's production— (short tons)	...	...	...	...	583,517	1,114,769	1,104,517	1,018,395	1,193,114	1,564,254

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 1912 to 1916.

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	2,964	4	814	4,000	321	*	†	8,103†
1912	2,384	6	3,457	4,500	223	1,681	52	12,303
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

* 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 1912 to 1916:—

TIN PRODUCED IN AUSTRALIA, 1881 to 1916.

State.		1881.	1891.	1901.	1912	1913.	1914.	1915	1916.
QUANTITY.									
New South Wales	Ingot	Tons. 5,824	Tons. 1,454	Tons. 648	Tons. 900	Tons. 913	Tons. 650	Tons. 857	Tons. 909
	Ore	609	203	11	1,175	2,118	1,667	1,331	1,220
Victoria ...	Ore	†	†	77	48	57	53	95	122
Queensland ...	Ore	†	†	1,661	3,230	3,197	2,085	2,125	1,707
West Australia (Ore & Ingot)	...	†	†	734	651	484	363	42	463
Tasmania ...	Ore	†	†	1,790	3,714	4,010	2,573	2,509	2,835
Northern Territory	Ore	...	†	81	271	258	180	14	270
VALUE.									
New South Wales...	Ingot	£ 531,303	£ 124,320	£ 76,086	£ 183,000	£ 182,800	£ 101,400	£ 135,350	£ 159,075
	Ore	37,492	9,643	464	155,074	238,492	165,730	131,430	117,422
Victoria ...	Ore	7,334	5,092	4,181	5,733	6,959	4,955	9,447	12,955
Queensland ...	Ore	193,699	116,387	93,723	364,503	343,665	176,197	183,472	181,401
West Australia (Ore & Ingot)	...	...	10,200	40,000	79,738	72,142	35,649	41,391	49,101
Tasmania ...	Ore	375,775	293,170	212,542	543,103	531,983	259,300	292,306	350,852
Northern Territory	Ore	...	1,938	5,586	27,001	25,526	15,200	13,245	27,120
Commonwealth	...	1,145,603	560,750	432,576	1,358,162	1,401,571	758,431	806,641	927,926

* Dressed tin ore, about 70% tin. † Not available.

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 1916 being 1272 tons, valued at £146,880. In the Tingha division the yield amounted to 700 tons, valued at £79,261, the yield from dredging being estimated at £59,896. The Emmaville division in the New England district shewed a yield of 1088 tons, valued at £128,406, of which dredging produced 445 tons, valued at £50,260. 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 170 tons, valued at £20,787. The Ardlethan field, in the Lachlan division, produced ore and concentrates to the value of £29,593.

(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 1916 was obtained in the Eldorado district. About £2000 worth was obtained at Beechworth, £1300 worth at Toora, and a small quantity at Digger's Creek.

(iii.) *Queensland.* The chief producing districts in Queensland during 1916 were Herberton, 821 tons, valued at £85,364; Stanthorpe, 309 tons, £34,542; Cooktown, 234 tons, £26,812; Chillagoe, 186 tons, £17,580; and Kangaroo Hills, 130 tons, £14,190. 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.

(iv.) *Western Australia.* The production of tin ore and ingot for the State during 1916 amounted to 463 tons, valued at £49,101, to which the Greenbushes field contributed 282 tons, valued at £27,319, and the Pilbara field 153 tons, valued at £15,939. There was no production from the other fields in 1916.

(v.) *Tasmania.* The tin ore raised in 1916 amounted to 2855 tons, valued at £350,852, as compared with the year 1913, when the production was returned as 4010 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 1916 came from the North-Eastern Division with 1385 tons of ore, valued at £187,023. Of the total yield in this division, 719 tons were contributed by the Pioneer and Gladstone districts, 395 tons by Derby, and 185 tons by Branhholm. The next highest output was returned from the North-Western Division with 746 tons, to which the celebrated Mt. Bischoff contributed 476 tons, and the Mt Bischoff Extended, 207 tons. In the Eastern Division, the Avoca mines produced about 211 tons.

(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.

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, 1912 to 1916.

1912.	1913.	1914.	1915.	1916.
Tons. 122,538	Tons. 124,890	Tons. 111,206	Tons. 112,819	Tons 112,741

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

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

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

4. **Prices of Tin.**—The average price of the metal in the London market for the year 1897 and from 1906 to 1916 was as follows:—

PRICE PER TON OF TIN, 1897 to 1916.

Year.	Price per Ton.	Year.	Price per Ton.
	£ s. d.		£ s. d.
1897	61 8 0	1911	192 7 0
1906	180 12 11	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	163 19 2
1910	155 6 2	1916	182 1 11

* Quotations incomplete.

According to "The Mineral Industry" the maximum price obtained for tin during the period 1897-1916 was reached in April, 1914, when the metal was quoted at £231 per ton.

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 1912 to 1916.

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
1912	2,646	57	2,153	409	1,762	287	7,314
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

§ 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 1916, 209,741 tons, valued at £961,849, the great bulk of the production being obtained from tailings. The following table shews the production of zinc in New South Wales from 1889 to 1916:—

NEW SOUTH WALES.—PRODUCTION OF ZINC, 1889 to 1916.

Year.	Quantity of Zinc (Spelter and Concentrates) Produced.	Value.	Year.	Quantity of Zinc (Spelter and Concentrates) Produced.	Value.
	Tons.	£		Tons.	£
1889	97	988	1913	506,661	1,547,987
1891	219	2,622	1914	359,310	1,020,711
1899	49,879	49,207	1915	190,916	1,111,569
1912	520,518	1,766,242	1916	209,741	961,849

The total quantity of zinc (spelter and concentrates) produced in New South Wales to the end of the year 1916 was 4,086,345 tons, valued at £12,182,029.

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.

During the year 1916, a small quantity of zinc, valued at £630, was produced in Western Australia.

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.

§ 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 1908-12.* 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 of bounties on iron in accordance with the terms set out hereunder :—

BOUNTIES PAYABLE ON AUSTRALIAN PIG IRON, BAR IRON, STEEL, Etc.

Description of Goods.	Rate of Bounty.	Total Amount which may be authorised.	Date of Expiry of Bounty.
CLASS 1.			
Pig iron made from Australian ore	12s. per ton	£150,000	30th June, 1914
Puddled bar iron made from Australian pig iron	"		
Steel made from Australian pig iron	"		
CLASS 2.			
Galvanised sheet or plate iron or steel (whether corrugated or not) made from Australian ore	10 per cent. on value	£30,000	30th June, 1914
Wire netting, not being prison made and being made from Australian ore or from wire manufactured in the United Kingdom	10 per cent. on value		
Wire made from Australian ore			
Iron and steel tubes or pipes (except riveted or cast), not more than six inches internal diameter, made from Australian pig iron or steel	10 per cent. on value		

Particulars of the bounties paid under the above Act during the half-year ended the 30th June, 1909, and during the financial years 1909-10 to 1914-15, are shewn in the following statement :—

**PARTICULARS OF BOUNTIES PAID ON PIG IRON, BAR IRON, STEEL, Etc.,
1909 to 1915.**

Period.	Steel made from Australian Pig Iron.	Puddled Bar Iron made from Aus- tralian Pig Iron.	Pig Iron made from Australian Ore.	Galvanised Sheet Iron made from Australian Ore.	Wire netting made from wire manu- factured in the United Kingdom.	Total.
	£	£	£	£	£	£
Half-year ended 30th June, 1909	575	568	2,314	192	...	3,649
1909-10	1,491	1,254	23,510	287	6,036	32,578
1910-11	1,940	2,080	20,462	121	4,824	29,427
1911-12	723	671	15,611	74	5,968	23,047
1912-13 ... ..	...	38	16,949	...	1,110	18,097
1913-14	7,136	...	40,121	...	4,554	51,811
1914-15	2,474	...	31,813*	...	593	34,880
Total	14,339	4,611	150,780	674	23,085	193,489

* Including £19,808 under Iron Bounty Act, see (ii.) infra.

(ii.) *The Iron Bounty Act 1914.* 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 £30,000. Provision was made for transfer, if required, to the State, of lands, buildings, etc., used in the manufacture of pig iron. During the financial year 1916-17, bounty amounting to £11,454 was paid on 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 ironworks at Lithgow, will be found in earlier issues of the Year Book (see No. III., p. 508). During 1916 the following materials were received at the blast furnace at the Eskbank Iron Works, Lithgow:—Iron ore, 90,182 tons; limestone, 37,565 tons; and coke, 79,518 tons. The output was 52,556 tons of pig iron, and the quantity of steel ingots made 20,762 tons. The iron ore was raised from quarries at Tallawang and Coombing Park.

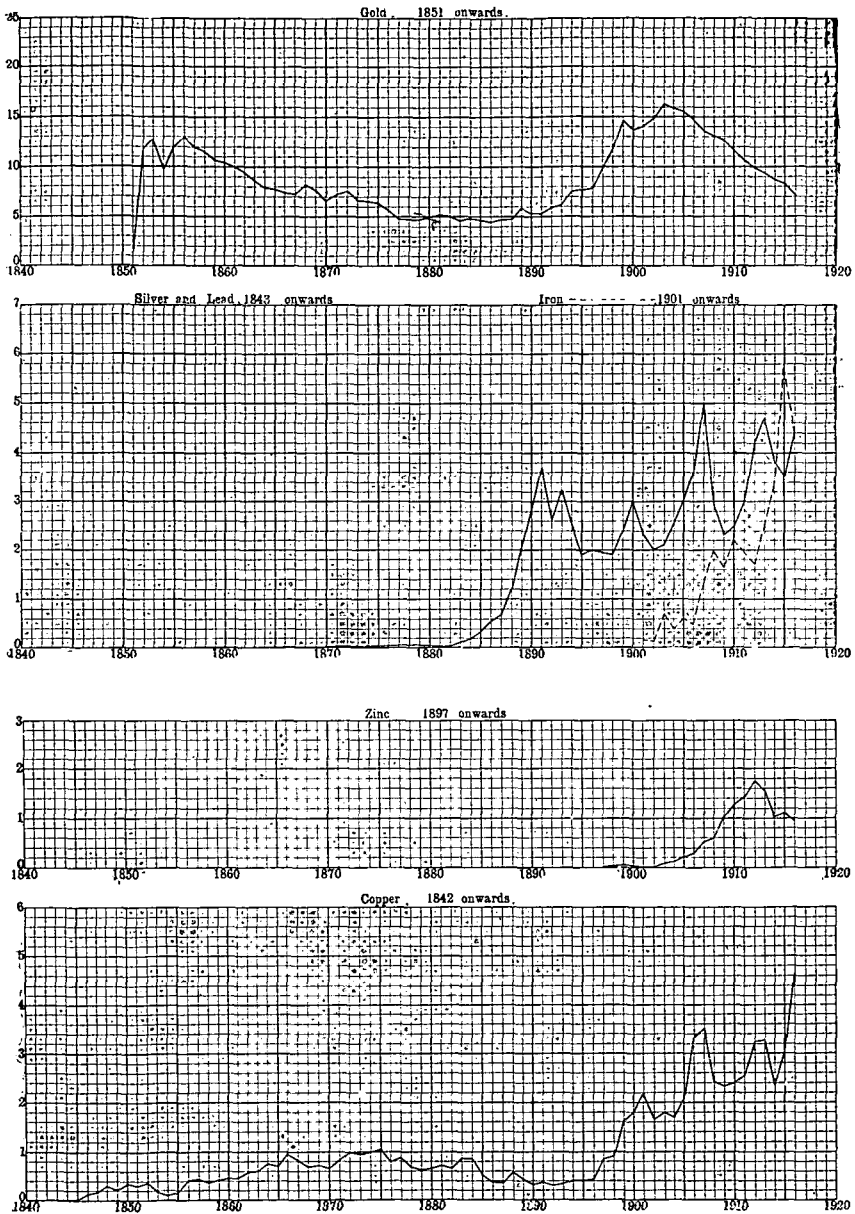
The Broken Hill Proprietary Company has established works for the manufacture of iron and steel on a large scale at Newcastle, and operations were started early in 1915. The Company is utilising the immense deposit of iron ore at the Iron Knob quarries in South Australia, abundant stores of first quality coal can be obtained from the various coalfields in the vicinity of Newcastle, and arrangements have been made for the local supply of the necessary quantities of limestone. The works have been planned so as to allow of ready extension as the business develops. During the year ended 30th November, 1917, the production of steel ingots amounted to about 130,000 tons. For the same period the blooming mill produced 134,000 tons, the rail mill 82,000 tons, the 18-inch mill 15,000 tons, and the 12-inch mill 988 tons.

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), 1910 to 1916.

Particulars.	1910.	1911.	1912.	1913.	1914.	1915.	1916.
Quantity Tons	40,487	36,354	32,677	46,563	75,150	76,318	52,556
Value ... £	161,948	145,416	130,708	186,252	254,257	267,000	197,085

GRAPHS SHEWING VALUES OF THE PRINCIPAL MINERALS PRODUCED IN THE
COMMONWEALTH, 1840 TO 1916.

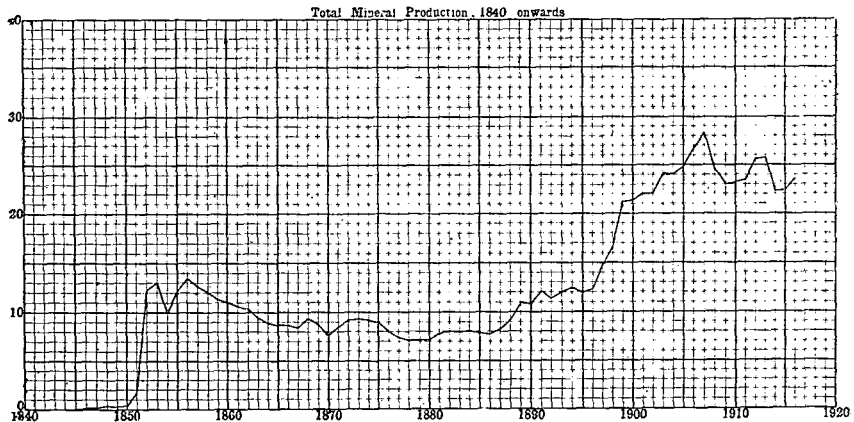
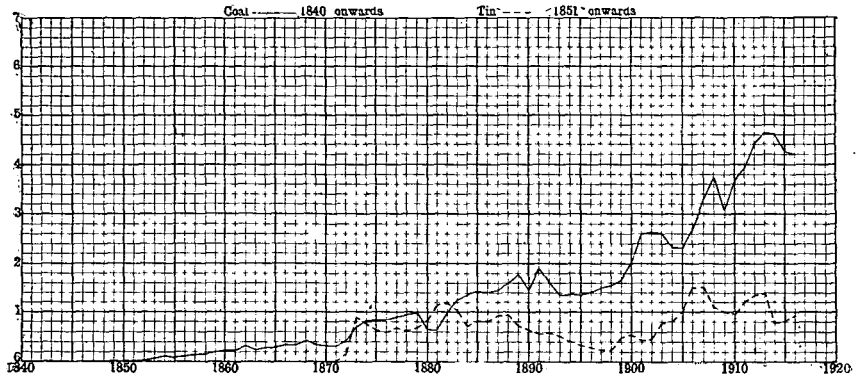


(See pages—for gold, 433; silver, 442; iron, 451; zinc, 450; copper, 445.)

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 1916.

The base of each small square represents an interval of one year, and the vertical height represents in the case of gold £1,000,000, in the case of silver and lead, zinc, and copper £200,000, and in the case of iron £20,000.

GRAPHS SHEWING VALUES OF THE PRINCIPAL MINERALS PRODUCED IN THE
COMMONWEALTH, 1840 to 1916.



(See pages 459 for coal ; 448, tin ; and 432 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 1916.

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.

The bounty paid in 1914, 1915, and 1916 on iron and steel made from ores mined in New South Wales was as follows:—

BOUNTY PAID ON IRON AND STEEL, NEW SOUTH WALES, 1914, 1915, and 1916.

Description.	1914.		1915.		1916.	
	Tonnage.	Bounty.	Tonnage.	Bounty.	Tonnage.	Bounty.
Pig iron ...	58,528	£ 35,117	75,000	£ 30,000	68,512	£ 27,405
Steel ...	14,929	8,957	...	...	...	...
Total ...	73,457	44,074	75,000	30,000	68,512	27,405

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 1916 the iron oxide raised amounted to 2461 tons, valued at £2695, while the total output to the end of that year was 25,000 tons, valued £46,000. 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 1472 tons, valued at £1083, were raised. The total raised for the period 1899-1916 amounted to 108,000 tons, valued at £83,000.

(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 1916, 44,161 tons of ironstone, valued at £37,781, were raised, of which 35,734 tons, valued at £35,036, came from the Rockhampton district, and about 8000 tons, valued at £2700, from the Cloncurry field.

(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 forty 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 ended November, 1917, was nearly 300,000 tons, of which about 224,000 tons were used at the works.

(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.

(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 3600 tons, valued at £1600, 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 1916 being 14,005 tons, valued at £13,597.

(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 coal deposits, 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 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 export of antimony (metal and ore) in 1916 amounted to 616 tons, valued at £13,334. The ore was raised mainly in the Hillgrove division, where it is found in association with scheelite and gold. The total quantity of antimony ore raised in New South Wales up to the end of 1916 was 17,961 tons, valued at £331,948. The production of antimony ore in Victoria during 1916 amounted to 12,382 tons, valued at £77,275. The whole of this ore was 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 £3965. In Western Australia lodes of stibnite carrying gold have been found in the Roeburne district. During 1916, 27 tons of antimony, valued at £580, were exported.

2. **Arsenic.**—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 2½ 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 30 tons of metal and ore, valued at £5473, were exported from New South Wales during 1916; the total quantity exported to the end of that year was

618 tons, valued at £143,030. In Queensland wolfram and bismuth have been found in various districts, but the chief centres of production in 1916 were the Herberton and Chillagoe fields. The total production in 1916 was valued at £78,412, of which £57,813 was returned as wolfram, £1530 as bismuth, and £19,069 as bismuth and wolfram. In South Australia deposits are found at Balhannah, at Mount Macdonald, and at Murnin-nie, on the shores of Spencer's Gulf. In Tasmania $3\frac{1}{2}$ tons, valued at £1059, were raised in 1916, 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 Gordon Brook, in the Clarence River district, at Bingara, Wallendbeen, and near Gundagai. The production during recent years has been trifling, the quantity raised in 1916 being 450 tons, from an area at Wood's Reef, Barraba. The total exports to the end of 1916 amounted to 31,985 tons, valued at £102,617. Chrome iron ore is found in Queensland in the Rockhampton district, where the Elgalla mine, at Cawarral, produced a small quantity in 1911.

6. **Carnotite.**—A discovery of carnotite ore was made in 1906 twenty 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 in 1915, and the total produced since 1860 amounted in value to only a little over £8000. 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 1916, amounted to 25,466 tons, valued at £799,632. The total lead exported to the end of 1916 was 243,506 tons, valued at £4,225,830. 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 1916 amounting to 615 tons, valued at £19,193, of which 314 tons were produced in the Burketown district, 189 tons at Etheridge, and 65 tons were recorded from the Herberton area. Pig lead to the value of £74,930 was exported from Western Australia in 1916. 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 quick-silver has been small, the total being only about 3000 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. 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 precludes mining to any great extent, and the production to date has been trifling. During 1916, 1924 tons, valued at £1443, were

raised at Grenfell. In Queensland there are extensive deposits at Mount Miller, and at Gladstone, the production in 1916 being 643 tons, valued at £2793. 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 Boolconda in South Australia some years ago. Deposits have also been noted at Kangaroo Island, Quorn, Tumby, and various other parts of the State. The production in 1916 was valued at £2700. 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 1916 being 54 tons, valued at £22,066, as compared with 32 tons, valued at £16,937, in the previous year. The production at Kingsgate was valued at about £7400. In the Deepwater division £5000 worth was obtained. A small quantity was also obtained in the Tenterfield division. The Whipstick mines yielded 25 tons of molybdenite, valued at £9900. There was a small production from Yetholme in the Bathurst division. The production in Queensland for 1916 was 81 tons, valued at £34,369, practically the whole of which was contributed by the mines 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. Molybdenite occurs in small quantities at various localities in Western Australia, and an attempt is being made to open up a deposit at Mulgine, on the South Yalgoo goldfield.

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 a small extent in New South Wales. During 1916 the export of wolfram was 183 tons, valued at £31,163, and of scheelite 81 tons, valued at £13,719. Wolfram was mined chiefly at Torrington, in the Deepwater division, and scheelite at Hillgrove. In Victoria small quantities of ore were raised during 1916 at Bendoc. In Queensland, tungsten ores are found in several districts, the chief centres of production in 1916 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 £20,000 was obtained in 1916 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. 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. Wolfram is mined at various points in Tasmania, the production for 1916 being 106 tons, valued at £16,910, obtained chiefly at Avoca and from the Shepherd and Murphy mine at Middlesex. Scheelite has been discovered on King Island in Bass Strait.

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 £9375, were exported, consisting of ore which had been raised some years previously at Wodgina, in the Pilbara field. 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 1916 amounted to 8,127,161 tons, valued at £3,336,419, or a decrease of about 1,322,000 tons in quantity, and £88,000 in value, as compared with the output in 1915. The decreased return in 1916 is accounted for largely by the lessened production from the Northern District Collieries consequent on the restriction of the export trade owing to the war.

(iii.) *Victoria.* During 1916, 420,098 tons of coal were raised, valued at £216,875. Of this total 354,146 tons, valued at £173,839, were raised by the State coal mine at Wonthaggi. The total production for 1916 was about 171,000 tons lower than in the preceding year.

(iv.) *Queensland.* The quantity of coal raised in 1916 was 907,727 tons, valued at £389,348, this production being smaller than in 1914 and 1915. Cessation of operations in consequence of an industrial dispute was chiefly responsible for the decreased output. Twenty-nine collieries were working in the Ipswich district, seven on the Darling Downs, four in the Maryborough district, one each in the Rockhampton and Chillagoe districts, and four at Blair Athol. 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 1916, and the output for the year was 301,526 tons, or about 15,000 tons more than in 1915.

(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 1916.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	C'w'lth.
QUANTITY.							
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1881	1,769,597	...	65,612	...	...	11,163	1,846,372
1891	4,037,929	22,834	271,603	...	...	43,256	4,375,622
1901	5,968,426	209,329	539,472	...	117,836	45,438	6,880,501
1912	9,885,815	593,155	902,166	...	295,079	53,560	11,729,775
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
VALUE.							
	£	£	£	£	£	£	£
1881	603,248	...	29,033	...	...	4,465	636,746
1891	1,742,796	19,731	128,198	...	...	17,303	1,908,028
1901	2,178,929	147,228	189,877	...	68,561	18,175	2,602,770
1912	3,660,015	259,321	338,264	...	135,857	24,568	4,418,025
1913	3,770,365	274,940	403,767	...	153,614	25,367	4,628,053
1914	3,737,761	289,099	416,292	...	148,684	27,853	4,619,689
1915	3,424,630	275,343	409,342	...	137,659	30,418	4,277,592
1916	3,336,419	216,875	389,348	...	147,823	27,736	4,118,201

The Victorian figures for 1916 include about 2900 tons of brown coal, valued at £580, raised at Altona.

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 4000 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 2884 feet. Towards the north, south and west the seams rise towards the surface, and outcrop in the neighbourhood of Newcastle, Bulli and Lithgow. The coal from the various districts embraced in this division differs considerably in quality—that from the Newcastle district being especially suitable for gas-making and household purposes, while the product of the Southern (Illawarra) and Western (Lithgow) is an excellent steaming coal. At the present time the Greta coal seams are being extensively worked between West Maitland and Cessnock, and this stretch of country, covering a distance of fifteen 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 1916:—

COAL RAISED IN NEW SOUTH WALES, 1881 to 1916.

District.	1881.		1901.		1911.		1916.	
	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	5,311,832	2,406,266
Southern ...	253,283	115,505	1,544,454	407,196	2,066,621	636,163	1,848,933	660,761
Western ...	163,842	50,473	424,720	102,214	831,337	210,329	966,396	269,393
Total ...	1,769,597	603,248	5,968,426	2,178,929	8,691,604	3,167,165	8,127,161	3,336,419

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., page 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. Attempts have been made to manufacture briquettes from the brown coal, but so far without any great measure of success. At the Melbourne and Altona Colliery Company's mine at Altona, 2915 tons of brown coal, valued at £583, were raised in 1916. 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, 1907 to 1916.

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.	£
1907	...	64,088	61,755	3,762	7,565	...	1,470	138,635	79,706
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	53,806	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

Included in the total for "other companies" is an amount of 14,672 tons raised by the Powlett North and Woolamai, and 2915 tons of brown coal raised by the Melbourne and Altona Colliery Co. at Altona.

(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. Arrangements have been made for opening up a deposit of brown coal at Bowen, on the Morgan Railway Line, about 87 miles from Adelaide.

(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 sixty 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 1000 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 1916.

Year.	...	...	1861.	1871.	1881.	1891.	1901.	1916.
Quantity	...	Tons	14,212	17,000	65,612	271,603	539,472	907,727
Value	...	£	9,922	9,407	29,033	128,198	189,877	389,348

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

QUEENSLAND COLLIERIES, 1914, 1915 and 1916.

Collieries.	1914.		1915.		1916.	
	Tons Raised.	Average Value at Pit's Mouth.	Tons Raised.	Average Value at Pit's Mouth.	Tons Raised.	Average Value at Pit's Mouth.
Ipswich ...	718,205	s. d. 7 1	682,491	s. d. 7 3	583,692	s. d. 7 11
Darling Downs ...	105,645	8 9	97,411	8 11	99,511	9 10
Nundah (Brisbane)	625	5 3	...	...	...	...
Wide Bay and Maryborough ...	118,120	11 4	104,358	11 10	79,726	12 2
Rockhampton (central) ...	7,818	8 9	6,741	8 6	5,034	9 6
Clermont ...	102,980	8 5	123,731	7 8	124,483	7 9
Mount Mulligan (Chillagoe) ...	597	17 2	9,541	12 7	15,281	13 4
Total... ..	1,053,990	7 11	1,024,273	8 0	907,727	8 7

It is estimated that more than one-third of the production from Ipswich was shipped as bunker coal, while the total amount shipped at the Brisbane railway wharves for bunkers, cargo, and other purposes was returned at 222,000 tons. The average value of Queensland coal in 1916 was the highest recorded for the last seventeen years.

(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 1916.

Year	1901.	1910.	1911.	1912.	1913.	1914.	1915.	1916.
Quantity Tons	117,836	262,166	249,890	295,079	313,818	319,210	286,666	301,526
Value £	68,561	113,699	111,154	135,857	153,614	148,684	137,859	147,823

(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 1916.

District.	1901.	1910.	1911.	1912.	1913.	1914.	1915.	1916.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
North-western ...	2,952	1,720	1,496	956	1,167	1,074	270	673
North-eastern ...	37,239	71,115	54,296	51,205	52,759	58,743	63,507	54,284
Midland ...	1,536	721	635	679	847	847	691	598
South-eastern ...	...	8,899	640	720	270	130	68	20
South-western ...	3,711							
Total ...	45,438	82,455	57,067	53,560	55,043	60,794	64,536	55,575

The bulk of the output in 1916 was raised from the Cornwall and Mt. Nicholas mines, in the North-eastern Division, which produced 22,839 and 30,624 tons respectively.

3. **Production of Coal in Various Countries.**—The total known coal production of the world in 1912 amounted to about 1100 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 1000 tons in 1901 and during each of the years from 1911 to 1915 where the returns are available:—

COAL PRODUCTION, BRITISH EMPIRE, 1901 and 1911 to 1915.

Year.	United Kingdom.	British India.	Canada.	Australian C'wealth.	New Zealand.	Union of S. Africa.
	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.
1901 ...	219,047	6,636	5,791	6,881	1,228	712
1911 ...	271,892	12,716	11,908	10,550	2,066	6,933
1912 ...	260,416	14,706	15,237	11,730	2,178	7,248
1913 ...	287,430	14,708	13,404	12,418	1,888	7,858
1914 ...	265,665	16,446	12,176	12,445	2,276	7,570
1915 ...	253,206	17,104	11,800	11,415	2,209	7,394

COAL PRODUCTION, FOREIGN COUNTRIES, 1901 and 1911 to 1915.

Year.	Russian Empire.	Sweden.	German Empire.	Belgium.	France.	Spain.	Japan.	United States.
	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.
1901 ...	16,215	268	106,795	21,856	31,136	2,609	8,885	240,789
1911 ...	28,414	355	172,065	22,603	38,602	3,853	17,632	447,854
1912 ...	30,640	360	174,575	22,972	40,648	3,686	19,640	443,188
1913 ...	32,206	364	150,109	22,858	40,192	4,283	21,316	477,202
1914 ...	33,113	367	161,535	...	29,311	3,600	19,372	508,893
1915 ...	...	412	...	...	19,590	3,722	...	458,506

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 1916 was 646,552 tons, valued at £415,560, of which amount 646,547 tons, valued at £415,549, 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 1916.

Year.	1881.	1891.	1901.	1911.	1912.	1913.	1914.	1915.	1916.
Quantity, 1000 tons ...	1,030	2,514	3,471	5,024	6,053	6,232	5,868	4,668	3,434
Value ... £1000	417	1,307	1,682	2,664	3,233	3,342	3,159	2,485	1,873

The principal oversea countries to which coal was exported from New South Wales during the year 1916-17 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, 1916-17.

Country.	Quantity.	Value.	Country.	Quantity.	Value.
	Tons.	£		Tons.	£
Chile ...	81,421	50,068	Java ...	29,394	16,355
Society Islands ...	9,555	6,267	Mauritius ...	1,910	1,355
Straits Settlements	40,993	28,035	Papua ...	4,062	2,536
Fiji ...	47,678	30,913	New Caledonia ...	22,124	16,667
New Zealand ...	320,272	205,889	Falkland Islands	3,223	1,692
Peru ...	15,156	10,879	Gilbert and Ellice Islands ...	3,728	2,309
Hawaii ...	21,096	13,518	Solomon Islands ...	2,075	1,572
United States ...	3,202	2,390	Pleasant Islands	2,239	1,291
India ...	36,653	22,421			

The quantity of bunker coal taken from New South Wales by oversea vessels was about 662,000 tons, valued at £457,000.

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, 1911 to 1916.

Year.	Exports to Australasian Ports.	Exports to other Ports.	Local Consumption.	Total.
	Tons.	Tons.	Tons.	Tons.
1911 ...	2,525,776	2,498,304	3,667,524	8,691,604
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

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, 1912 to 1916.

Year.	Quantity of Coal Consumed.			
	Home Produce.	Produce of the United Kingdom.	Produce of Other Countries.	Total.
	Tons.	Tons.	Tons.	Tons.
1912	7,907,000	1,500	14,000	7,922,500
1913	8,671,491	872	3,577	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

The bunker coal taken away in 1916 is estimated at 950,000 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., and in 1916, 8s. 3d. per ton. 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 (PER TON), 1912 to 1916.

Year.	Northern District.	Southern District.	Western District.
	s. d.	s. d.	s. d.
1912	8 1.15	6 1.06	4 11.98
1913	7 9.91	6 1.13	5 1.85
1914	7 8.26	6 4.12	5 6.83
1915	7 7.24	6 11.23	5 6.08
1916	9 0.72	7 1.77	5 6.90

(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, 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. These averages are exclusive of brown coal, the production of which in 1916 was valued at 4s. per ton.

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

PRICE OF COAL, QUEENSLAND, 1912 to 1916.

District.	Value at Pit's Mouth.				
	1912	1913.	1914.	1915.	1916.
	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
Ipswich	6 7	7 0½	7 1	7 3	7 11
Darling Downs	8 6½	8 6	8 9	8 11	9 10
Nundah (Brisbane) ... ..	...	...	5 3	...	...
Wide Bay and Maryborough	10 10½	10 11	11 4	11 10	12 2
Rockhampton	10 6	10 4	8 9	8 6	9 6
Clermont	7 6	7 7	8 5	7 8	7 9
Mount Mulligan (Chillagoe) ... ..	...	...	17 2	12 7	13 4

(iv.) *Western Australia.* The average price of the Collie (Western Australia) coal up to the end of 1901 was 9s. 4d. per ton, the price in 1901 being 11s. 7d. In 1902 the average stood at 12s. 3d., and from that time the price fell steadily until 1906, when it was 7s. 7½d. per ton. In 1907, the average price was 7s. 8½d.; in 1908, 8s. 7½d.; in 1909, 8s. 5½d.; in 1910, 8s. 8d.; in 1911, 8s. 10d.; in 1912, 9s. 2d.; in 1913, 9s. 9d.; in 1914, 9s. 4d.; in 1915, 9s. 8d., and in 1916, 9s. 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., and in 1916, 9s. 9d. 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. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
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. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
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 1916 is shewn below. The table also shows the number of persons killed and injured, with the proportion per 1000 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 1000 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 1000.

EMPLOYMENT AND ACCIDENTS IN COAL MINING, 1916.

State.	Persons Employed in Coal Mining.	No. of Persons.		Proportion per 1000 Employed.		Tons of Coal Raised for Each Person.	
		Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
New South Wales ...	16,892	13	55	0.77	3.26	625,000	148,000
Victoria ...	1,281	...	18	...	14.00	...	23,300
Queensland ...	2,037	2	30	0.98	14.72	454,000	30,300
Western Australia ...	458	...	86	...	188.00	...	3,500
Tasmania ...	167	...	4	...	24.00	...	13,900
Commonwealth	20,835	15	193	0.72	9.26	654,000	50,800

§ 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 1916-17, the import amounted to only 307 tons, valued at £938, of which 306 tons, valued at £929, came from the United Kingdom. The table hereunder gives the production in New South Wales during the last five years:—

COKE MADE IN NEW SOUTH WALES, 1912 to 1916.

Year.	1912.	1913.	1914.	1915.	1916.
Quantity ... Tons	241,159	298,612	304,800	417,753	437,587
Value, total ... £	162,454	208,989	213,069	313,241	387,571
Value per ton ...	13s. 5d.	14s. 0d.	13s. 11d.	15s. 0d.	17s. 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 1916 being 17,904 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, 1912 to 1916.

Year.	1912.	1913.	1914.	1915.	1916.
Manufactured locally tons	38,136	14,942	16,685	17,085	17,904

It is estimated that the total amount of coke consumed for smelting purposes in Queensland during 1916 was 68,500 tons, of which 17,904 tons were produced locally, and 50,544 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, cannel, or boghead mineral found at various geological horizons in New South Wales. The mineral does not, as a rule, split in parallel layers, the fracture being rather of a conchoidal type. Pure samples have been found to contain over 89 per cent. of volatile hydro-carbons. The discovery of the mineral in New South Wales dates probably as early as 1802. Its occurrence in the Hartley Vale district was noted by Count Strzelecki in 1845. The mineral has been found at several places in the Upper Coal Measures, and in at least two in the Lower Carboniferous. Production on anything like a large scale commenced in 1868, when about 17,000 tons, valued at £48,000, were raised. The production in 1916 amounted to 17,425 tons, valued at £17,772, as compared with 15,474 tons, valued at £12,890, in 1915. For 1916 the greater portion of the output was won at Wollan and Torbane.

(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 prospecting will lead to the discovery of mineral oil in quantity in this locality. At the end of 1916 the bore had reached a depth of 1450 feet, and the 15½-inch and 12½-inch casings had been successfully cemented in. Boring was continued to a depth of 2875 feet in 1917. Oil-bearing shales are common in many parts of the State. The deposit at Duaringa on the Central railway line shewed a thickness of 6 feet, and contained about 30 gallons of oil to the ton. Inflammable gas and a little oil have been noted in bores put down for coal on the Dawson River. There are shale deposits at Munduran Creek, near Gladstone, Casuarina Island, Redbank Plains in the Ipswich District and Murphy's Creek, near Toowoomba. It is stated that the borings have not so far penetrated to a sufficient depth to properly test the strata.

(iv.) *South Australia.* 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 £5000 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 have been taken out, and boring operations are being carried on near Kingston and near Robe, the bore at the latter having reached a depth of nearly 4,000 feet.

(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 are 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 1286 tons of shale, valued at £1286. 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.

(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.

2. **Export of Shale.**—In 1916 New South Wales exported 19 tons of shale, valued at £84.

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 £809 on 324 tons of refined paraffin wax. As the bounty expired on the 30th June, 1913, the articles mentioned were produced prior to that date.

§ 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 1916, 46,000 tons had been exported, valued at £148,303, the exports for the year 1916 being 325 tons, valued at £1980.

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

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 analysed have proved richer in valuable constituents than any similar find yet recorded. The production in 1916 was valued at £670. Another deposit has been located near Warnertown.

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. 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. Deposits are found at various places in Queensland, but so far the product is somewhat inferior, the want of tensile strength being the chief drawback. In Western Australia what may prove to be a valuable deposit of the fibrous chrysotile variety has been located at Soanesville, on the Pilbara goldfield, and in 1909 £154 worth of this mineral was raised. 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. 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 1916 about 185 tons of barytes, valued at £278, were obtained in the Mudgee division, and 500 tons, valued at £1250 were raised in the Canowindra district.

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 1916 amounted to 1744 tons, valued at £1336, raised in the Murrumburrah, Molong, Gulgong, and Goulburn divisions, and at Wallendbeen, Boxer's Creek and Home Rule. Fireclay to the amount of 26 tons was raised in the Molong division. Deposits of steatite were worked during 1916 in the Murrumburrah division, the quantity raised during the year amounting to 237 tons. Near Morangaroo 6500 tons of silica were raised by the Silica Fire Brick Company. About 40 tons of ochre, valued at £60, were raised in the Dubbo division. In Victoria 200 tons of kaolin were obtained at Pyalong, and 610 tons at Egerton, the value being given as £1200. In Queensland 8708 tons of fireclay, valued at £1771, were mined during the year 1916 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.

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 1912, from leases near Narrabri, in New South Wales, the total sold amounting to 50 tons, valued at £287. During 1916 about 110 tons were produced in the Narrabri division.

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 1916 from a site on the Bookookarara 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. A deposit has been located in the hundred of Roberts, about 9 miles N.W. of Arno Bay in South Australia. 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 1916 there was a production of 1853 tons, valued at £1853, obtained at Boort. Numerous deposits of gypsum are found in Southern Yorke's Peninsula in South Australia. 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 1916, 3516 tons, valued at £6583, were raised at Fifield, and 200 tons, valued at £200, at Attunga. The mineral is found at Heathcote in Victoria, where 30 tons, valued at £90, were produced in 1916. 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 £1196, were exported from Western Australia, but the export in 1916 amounted to 12 tons only. 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 Bunyan, in the Cooma division, 227 tons of diatomaceous earth, valued at £671, were produced in 1916. A small quantity also was raised in the Lismore division. 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. Fairly extensive deposits of diatomite exist in Queensland, in the Nerang, Beaudesert and Canungra 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 are obtained from dried-up shallow lakes and consumed locally or exported. The chief centres of production were formerly Rottnest Island, near Fremantle, and Middle Island, near Esperance, but the greater part of that now produced is obtained at Port Gregory.

12. Natural Manures.—Gypsum has already been referred to. (See 8 *ante*.) South Australia possesses deposits of rock phosphate near Port Clinton and Ardrossan on Yorke Peninsula, at Belvedere near Kapunda, and at Koorunga, and also at many other places which have only been prospected to a small extent. 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 1700 tons of phosphate, valued at £6000, were raised during 1916. 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 diamondiferous deposits were located. Stones of small size are also found at Cope's Creek and other places in the Inverell district. The largest diamond won in New South Wales was reported to have been obtained in 1905 at Mt. Werong, near Oberon, and weighed 28 $\frac{5}{8}$ carats. It is difficult to secure accurate returns in connection with the production of precious stones, but the yield of diamonds in 1916 was estimated at 1901 carats, valued at £1375, while the total production to the end of 1916 is given at 188,864 carats, valued at £129,071. The yield in 1916 was contributed by miners working in the vicinity of Copeton, in the Tingha division. Owing to the absence of a market consequent on the war the production in 1916 shewed a great reduction on that for 1913, when 5573 carats, valued at £5141 were won. 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 show 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 1916 was valued at £14,733, 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 a few casual buyers operate occasionally. About 270 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 1916, however, out of a total production valued at £21,273, the yield from the Lightning Ridge field, near Walgett, amounted to £20,610, while the output from the White Cliffs field was only £663. The war has 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 $6\frac{1}{2}$ 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 £1,413,910.

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 1916 was estimated at £500, and up to the end of that year at £178,195. 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 1916 amounted to £750.

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 2225 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 1000 carats of emeralds, valued at about £1650, were obtained. The largest stone in the rough weighed 60 carats. Small emeralds of fine quality have been found at Poona, in Western Australia, and it is stated that prospecting at greater depths would possibly reveal the existence of larger specimens. Amongst other gems found in New South Wales at various times may be mentioned *turquoises*, discovered in 1894, near Bodalla; *topazes*, fine specimens of which have been obtained in the New England district; and *zircon*s and *garnets*. Zircons of small size are plentifully found in the vicinity of Table Cape in Tasmania. Topazes are common in the tin drifts of Tasmania, and some fine specimens have been found. Turquoises are also found in thin veins in Victoria. In Gascoigne's mine, situated near the King River, in the parish of Edi, samples of the gem have been found equal in colour to the best Persian stone, and a considerable quantity of turquoises from this mine has been sold in England and Germany. Fine *agates* are found in many places in Victoria, but have not been made use of to any extent. 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 Poona in Western Australia. Very large but impure beryl crystals have been found at Ben Lomond in Tasmania. Some fine samples of *chiasolite* 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 1916 the number so employed was as follows :—

NUMBER OF PERSONS ENGAGED IN MINING, 1916.

State.	Number of Persons Engaged in Mining for						Total.
	Gold.	Silver, Lead, and Zinc.	Copper.	Tin.	Coal and Shale.	Other.	
New South Wales ...	2,317	6,461	1,661	1,938	16,892	2,035	31,304
Victoria ...	6,402	...	...	135	1,281	368	8,186
Queensland ...	1,900	62	2,922	1,093	2,037	1,031	9,045
South Australia ...	150	25	2,000	...	...	625	2,800
Western Australia ...	9,563	244	113	235	458	29	10,642
Tasmania ...	176	555	1,719	1,217	167	30	3,864
Northern Territory*	99	86	97	154	...	40	476
Commonwealth ...	20,607	7,433	8,512	4,772	20,835	4,158	66,317

* Estimated.

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 1916.

State	1891.		1901.		1916.	
	Miners Employed.	No. per 100,000 of Popu- lation.	Miners Employed.	No. per 100,000 of Popu- lation.	Miners Employed.	No. per 100,000 of Popu- lation.
New South Wales ...	30,604	2,700	36,615	2,685	31,304	1,674
Victoria ...	24,649	2,151	28,670	2,381	8,186	581
Queensland ...	11,627	2,934	13,352	2,664	9,045	1,335
South Australia ...	2,683	834	7,007	1,931	2,800	647
Western Australia ...	1,269	2,496	20,895	11,087	10,642	3,381
Tasmania ...	3,988	2,695	6,923	4,017	3,864	1,950
Northern Territory ...	...	...	...	...	476	...
Commonwealth ...	74,820	2,341	113,462	2,992	66,317	1,351

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, 1916.**—The following table gives particulars of the number of men killed and injured in mining accidents during the year 1916 :—

NUMBERS KILLED AND INJURED IN MINING ACCIDENTS, 1916.

Mining for—	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	N. T.	Cwlth.
KILLED.								
Coal and shale	13	...	2	...	...	...	...	15
Copper ...	5	...	7	4	...	...	...	16
Gold...	1	6	1	...	21	...	...	29
Silver, lead and zinc ...	14	...	...	...	...	...	...	14
Tin ...	1	...	...	...	...	...	...	1
Other minerals	...	...	...	...	...	2	...	2
Total ...	34	6	10	4	21	2	...	77
INJURED.								
Coal and shale	55	18	30	...	86	4	...	193
Copper ...	1	...	30	1	3	34	...	69
Gold...	1	19	23	...	755	...	...	798
Silver, lead and zinc ...	24	...	1	...	...	3	...	28
Tin ...	2	...	1	...	...	...	...	3
Other minerals	3	...	8	...	1	10	...	22
Total ...	86	37	93	1	845	51	...	1,118

§ 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 1916 the total sum expended in this manner amounted to £472,118, of which £10,371 was advanced in 1916. During the year the Government subsidy to the Miners' Accident Relief Fund amounted to £11,295.

3. **Victoria.**—Under the Mining Development and Surplus Revenue Acts the sum of £474,723 was expended from revenue, and £285,566 was provided out of votes during the period 1897 to 1916 as follows :—

	£
Advances to mining companies ...	234,207
Advances to prospectors ...	93,404
Boring for gold and coal ...	241,249
Construction of roads and tracks ...	62,990
Erection of testing plants, batteries, etc. ...	87,970
Miscellaneous, cyanide patents, Schools of Mines, etc.	40,469
Total ...	760,289

The expenditure in 1916 was £47,360, of which £23,044 was advanced to companies; £7,558 was loaned to miners; £213 was spent on constructing roads, etc.; £3,028 on boring for gold, coal, etc., and £8,517 on testing plants and miscellaneous. The Government batteries number 30, 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 £1,479.

4. **Queensland.**—State assistance to the mining industry in 1916 amounted to £27,751, of which £9,406 consisted of loans in aid of deep sinking; £5,616 grants in aid of prospecting; £1,676 in aid of roads and bridges to gold and mineral fields; £1,307 advance under Mining Machinery Advances Act 1906; £4,987 purchase of boring plant and boring for oil at Roma, and £4,759 purchase of diamond drilling plants.

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 1916 the total amount of subsidy paid was £64,123, of which £9,904 has been repaid, leaving a debit of £54,219. 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. During 1916 the advances made amounted to £2,312, of which nearly £1,600 represented aid given to prospectors for tin.

6. **Western Australia.**—Under the Mining Development Act of 1902 assistance was granted in 1916 in accordance with the subjoined statement:—Advances in aid of mining work and equipment of mines with machinery, £1,368; advances in aid of erection and equipment of crushing plants, including subsidies on stone crushed for the public, £1,761; advances in aid of boring, £119; providing means of transport, £338. In addition, amounts totalling in all £1,802 were expended from the Mining Development vote on various matters such as water supply, roads, cartage, and subsidies for development below the 100 feet level in small mines. Included in the amount of £1,761 is a sum of £627 paid to owners of plants crushing for the public. The receipts under the Act came to £5,857, of which £3,930 consisted of refunds of advances.

In 1916 there were 32 State batteries in operation. The amount expended thereon up to the end of 1916 was £91,981 from revenue and £272,534 from loan, giving a total of £364,515. During the year receipts amounted to £45,258, and working expenditure to £51,178.

The total value of gold and tin recovered to the end of 1916 at the State plants was £4,736,000, resulting from the treatment of 1,114,460 tons of gold ore and 70,970 tons of tin ore.

7. **Tasmania.**—Under the terms of the Aid to Mining Act 1912 the expenditure for the year 1916 amounted to £244, and the total up to the end of that year to £18,899. 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 £4,078 was expended during 1916, while the outlay to the end of that year was £54,888. 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 £289 was expended in 1916, the total expenditure under this Act being £7,278. Further, a sum of £8,979 was expended under the Mining Appropriation Act of 1905 in respect to the State mine at Zeehan. The practice 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 1916-17 the Government aid to mining amounted to £14,596, distributed as follows:—For shaft sinking, £6,174; prospecting, £7,170; purchase of machinery, £900; diamond drilling, £352. Since the passing of the Encouragement of Mining Ordinance in 1913, a sum of £18,566 has been paid in subsidies. There are Government batteries at Maranboy and Hayes Creek.

§ 17. Commonwealth Government Control of Industrial Metals.

1. **General.**—Prior to the declaration of war by Great Britain, practically the whole of the base metal production in Australia had been sold to representatives of the German metal organisation. The outbreak of hostilities threw the industry into chaos, and steps were immediately taken to cancel existing agreements, and to establish the industry on a sound and permanent foundation, consistent with British interests.

The following legislative and administrative acts may be cited:—

- (i.) Cancellation of all mineral and metal contracts with enemy companies and firms.
- (ii.) Dissolution of the Lead Convention controlled by Germans which determined the price to consumer and producer of all Australian lead.
- (iii.) Dissolution of the Zinc Combine—a purely German combine which controlled the world's spelter market, determining price, output, and manipulating the market as it pleased in the interests of Germany.
- (iv.) Elimination of the German interests in the copper industry of Australia.
- (v.) Elimination of all enemy agencies controlling tin, molybdenite, wolfram, and other metals.

The policy of the 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.

2. **Lead.**—Steps taken by the Commonwealth Government resulted in the formation and extension of the Broken Hill Associated Smelters Proprietary Limited, which has taken over the Broken Hill Proprietary Works at Port Pirie, South Australia. The new company is a co-operative institution for the smelting of silver-lead ores and concentrates, and the refining of the silver-lead bullion. It has one of the largest silver-lead smelting works in the world, with a capacity for an output of 160,000 tons of pig lead, and 5,000,000 to 6,000,000 ounces of silver per annum.

The Sulphide Corporation Limited continues to improve and enlarge its lead smelting works at Cockle Creek, near Newcastle, New South Wales. The refinery plant is now in operation and the output of some 60,000 tons of lead per annum with silver and gold made available locally. The works cater for all the smaller mines of New South Wales, Victoria, Queensland and Tasmania, in addition to two of the Broken Hill mines.

The Fremantle Smelters, Fremantle, Western Australia, are owned by 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 soft pig lead per annum. The plant in operation has a capacity for an annual output of about 7,000 tons of pig lead.

3. Zinc. A new company, the Zinc Producers' Association Proprietary Limited, has been formed to control and dispose of the output of zinc concentrates produced within the Commonwealth. All the principal zinc-producing companies are members, and the Association is founded on a co-operative basis. One of the fundamental principles is "equality of treatment" to all members. The Commonwealth Government is represented on the Board, thus safeguarding the interests of the general community.

The output of zinc concentrates within the Commonwealth for the twelve months ended 31st December, 1917, was 294,800 tons, and arrangements have been made whereby 40 per cent. of the normal output may be reserved for local treatment. The Electrolytic Zinc Company of Australasia Proprietary Limited has been formed, and the first unit of the refinery is now in operation. A contract for electrical power has been arranged with the Tasmanian Government, and technical experts have been engaged to install the plant and work the process. 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. The Mount Lyell Mining and Railway Company Limited, having acquired mines on the West Coast of Tasmania containing large bodies of complex sulphide ores, has 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. The enlargement of the Broken Hill Associated Smelters' zinc distillery at Port Pirie is also receiving attention.

4. Copper.—A new company, the Copper Producers' Association Proprietary Limited, has been formed on the same lines as 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. As in the case of the Zinc Producers' Association, the Commonwealth Government is represented on the Board of Directors.

The Australian production of copper amounts to approximately 40,000 tons per annum. The whole of this copper is refined in Australia. The Copper Producers' Association has accepted an offer from the British Ministry of Munitions for the Australian output of copper to the 30th June, 1918, excepting copper required for local consumption and copper sold under existing contracts. The amount involved under the contract will be approximately £2,150,000. The price to be paid for electrolytic and/or Wallaroo copper will be £108 per ton f.o.b. Sydney, and for other brands £106 per ton f.o.b. Sydney. If the production of other brands exceeds one-fourth of the total tonnage, the Munitions Department require an abatement in the price of £4 per ton, thus reducing the price for the excess to £104 per ton. The maximum quantity that may be delivered under the contract is 20,000 tons and the minimum 15,000 tons. If the maximum should be exceeded, the surplus will be taken by the British Ministry of Munitions at a price to be negotiated. If, however, the minimum is not reached, the Ministry of Munitions may claim delivery of the deficiency later at the contract price, but has no right to action for breach of contract.

The companies which are members of the Association are represented on the Board of Directors by the following members:—

Messrs. Bowes Kelly, Chairman, J. M. Niall, Vice-Chairman, Hon. W. L. Baillieu, Messrs. H. R. Denison, W. H. Fletcher, General F. G. Hughes, Mr. Percy Pigott, Sir J. Lancelot Stirling, Mr. J. L. Wharton. Sir J. M. Higgins, is the Government representative on the Board.

The Executive Committee appointed by the Board to carry on the general business of the Association consists of Messrs. Bowes Kelly, J. M. Niall, J. L. Wharton, Hon. W. L. Baillieu, Sir J. Lancelot Stirling, and Sir J. M. Higgins (Government representative).

The "Metal Manufacturers Limited" which was formed for the production of copper wire, tubes, sheets, etc., will, when the works are completed, be in a position to meet all Australian requirements.

5. **Tin.**—Encouragement is also given to the refining of tin ore and tin concentrates within the Commonwealth. The principal tin smelters are the Mount Bischoff Company, Tasmania, the Sydney Smelting Company (Pymont Works), New South Wales, and the Irvinebank Company, Queensland.

6. **Molybdenite, Wolfram and Scheelite.**—The Commonwealth Government entered into an agreement with the Imperial Government for the acquisition of all wolfram, molybdenite, etc., produced in Australia. Under this agreement 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 % WO_3	52s. 6d. per unit at producing centres.
Molybdenite	... 85 % MoS_2	100s. per unit at producing centres.

7. **Formation of Metal Exchange.**—Another action of the Government towards the elimination of German influence was the creation of an Australian Metal Exchange with offices at Melbourne and Sydney. No metals or minerals can be exported from Australia unless first registered with the Exchange by an active member, and, during the war, with the consent of the Minister for Trade and Customs. The members of the Exchange must be natural-born British subjects, and the Attorney-General has the right of veto with regard to membership during the war and twelve months after.