

SECTION XII.

MINES AND MINING.

§ 1. *The Mineral Wealth of Australia.*

1. **Place of Mining in Australian Development.**—Although Australia is pre-eminently a pastoral and agricultural country, the value of the production from its flocks and herds and from its farming industry far exceeding the return from mining, yet its mines and its mining developments are of great and increasing importance. It may also be said that it was the discovery of its immense stores of mineral wealth that first attracted population to Australia, and thus laid the foundation of its nationhood. Though coal was the first discovered mineral of recent times, it was the discovery of gold, overshadowing in popular estimation the former, which brought about a large influx of population and the formation of various settlements.

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 more remarkable even 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 metals has long been known. Thus, 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, 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 1908.**—It could scarcely be expected that the value of the Commonwealth's mineral production for the year 1908 would be equal to that of the previous twelve months, in view of the pronounced fall in the price of all industrial metals which occurred late in 1907, and which was sustained during the whole of 1908. The immediate result of this fall was not only a reduced production by some of the larger mines, but the closing of many of the smaller properties which were unable to shew a margin of profit, with a marked decrease in prospecting operations. Nevertheless, the value of the mineral production of the Commonwealth during 1908 exceeded that of previous years with the exception of 1905, 1906, and 1907, and must therefore be taken as satisfactory when the disabilities under which the industry laboured are taken into consideration. The value of the production in 1908 was £24,544,374, as against £28,301,346 in 1907. The value of the production from all minerals raised in each State during 1908 is given in the following table:—

MINERAL PRODUCTION IN 1908.

Minerals.	N.S.W.	Victoria.	Q'land.	S.A.	W.A.	Tas.	C'wealth.
	£	£	£	£	£	£	£
Alunite ...	2,705	...	...	...	...	...	2,705
Antimony ...	1,141	10,428	469	...	...	...	12,038
Asbestos ...	...	...	...	...	1,600	...	1,600
Bismuth ...	2,017	...	2,915	300	...	462	5,694
Chrome ...	...	...	240	...	...	...	240
Coal ...	3,353,093	64,778	244,922	...	75,694	24,427	3,762,914
Coke ...	199,933	...	...	...	...	...	199,933
Copper ...	502,812	3,928	893,535	345,968	57,091	609,651	2,412,985
Diamonds ...	1,358	...	...	...	...	...	1,358
Diatomaceous earth	...	600	...	...	...	...	600
Gold ...	954,854	2,849,838	1,963,315	36,243	6,999,882	242,482	13,046,614
Graphite ...	...	...	60	...	...	...	60
Gypsum ...	...	1,085	...	...	...	...	1,085
Iron ...	98,777	...	2,874	...	...	...	101,651
Iron oxide ...	1,857	...	...	...	...	1,600	3,457
Ironstone flux ...	6,199	...	48,047	39,600	...	...	93,846
Kaolin ...	...	591	1,072	...	...	...	1,663
Lead ...	186,746	...	5,072	...	...	...	191,818
Limestone flux ...	14,779	...	51,706	6,000	...	...	72,485
Manganese ...	...	...	5,524	...	...	...	5,524
Molybdenite ...	929	...	9,224	...	...	...	10,153
Opal ...	41,800	...	2,500	...	...	...	44,300
Platinum ...	439	...	...	...	...	...	439
Salt ...	...	*	...	37,500	...	...	37,500
Sapphires ...	...	...	15,200	...	...	...	15,200
Scheelite ...	11,082	...	20	...	...	...	11,102
Shale ...	26,067	...	...	...	...	...	26,067
Silver ...	253,920	2,835	44,520	...	18,877	...	320,152
Silver-lead bullion	1,906,275	...	...	9,030	...	322,007	2,399,442
Silver-lead ore	...	...	157,124	...	5,006	...	...
Tin ...	205,447	6,070	341,566	35,876	83,595	421,580	1,094,134
Wolfram ...	6,742	252	38,104	1,925	...	338	47,361
Zinc ...	600,883	...	...	...	98	...	600,981
Unenumerated ...	1,661	22,642	...	15,500	3,160	...	42,963
Total ...	8,381,516	2,963,047	3,823,009	527,942	7,245,003	1,622,547	24,568,064

* Not available for publication.

The figures in the above table do not in all cases coincide with those published by the Mines Departments, as they are exclusive of certain items such as building stones, clay, cement, and lime, which appear in some of the mining returns. The New South Wales Mining Report gives the production of building stone up to the end of 1908 as £18,030 (this figure, however, representing exports alone), while the production in Victoria during the period 1866-1907 is given in the Victorian Mines Report as £3,537,644. For comparative purposes the figures are therefore valueless, the utility of export figures for such a commodity as building stone being more or less dubious.

4. **Total Production to end of 1908.** In the next table will be found the estimated value of the total mineral production in each State up to the end of 1908. The figures given in this table are also exclusive of the same items referred to in connection with the preceding table.

COMMONWEALTH MINERAL PRODUCTION TO END OF 1908.

Minerals.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	C'wealth.
	£	£	£	£	£	£	£
Gold ...	56,319,736	282,321,433	68,277,156	2,785,852	85,004,290	6,766,303	501,474,770
Silver and lead ...	49,873,828	909,100	1,753,314	410,807	596,541	5,149,833	57,993,423
Copper ...	9,703,215	213,179	6,313,083	26,626,845	773,838	8,232,878	51,863,036
Tin ...	8,243,261	762,757	6,950,156	215,143	817,239	9,760,456	26,749,012
Coal ...	56,632,255	1,635,729	4,121,425	...	617,760	447,108	63,454,277
Other ...	10,089,330	323,535	1,276,262	1,140,826	72,440	466,787	13,369,230
Total ...	190,861,625	285,465,783	88,691,396	31,179,473	87,882,108	30,823,365	714,903,750

The "other" minerals in New South Wales include antimony, £300,698; bismuth, £121,899; chrome, £101,108; diamonds, £107,503; opal, £1,109,899; oil shale,

£2,193,568; and zinc, £2,027,777. In the Victorian returns antimony ore was responsible for £204,529. Included in "other" in the Queensland production were opal, £161,195; gems, other, £117,477; bismuth, £90,290; wolfram, £479,097; antimony ore, £50,881; manganese, £54,156; limestone, £158,056; and ironstone, £98,934. The chief item in South Australian "other" minerals was salt, £682,000. In the Tasmanian returns limestone flux was responsible for nearly £100,000.

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. With regard to the discovery of the various minerals and to the historical development of their production, it is only proposed to give in this section a brief summary of the more important facts. A more extended account of these matters was given in the Year Books Nos. 1 and 2, to which reference may be made.

METALS (A).

§ 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 reference to the population figures prior and subsequent to the year 1851 amply demonstrates this fact. Thus on 31st December, 1841, the population of the Commonwealth was only 220,968¹; at the end of 1851 it was still under half a million, viz., 437,665¹, while by the end of 1861 the total had reached 1,168,149¹ persons, that is, the population had quintupled itself in twenty years. A short account of the chief discoveries in each State is appended:—

(i.) *New South Wales.* The first authentic discovery of the precious metal in this State was made by "Assistant-Surveyor" James McBrien, on the 16th February, 1823, in the neighbourhood of the Fish River, and not far from the scene of Hargraves' memorable discovery twenty-eight years later. In 1839 Count Strzelecki reported the existence of gold in the Vale of Clwydd, near Lithgow, while the Rev. W. B. Clarke discovered the precious metal on the Cox River in 1841, and on the Wollondilly in 1842. In 1851, Hargraves found payable deposits of alluvial gold at Lewis Ponds and Summer Hill Creek, and on the Macquarie River. The news of these discoveries, amplified and distorted by all sorts of rumours, soon caused an enormous influx of people into Australia. The dates of other important finds were as follow:—Rich alluvial leads at Forbes, in 1862; Rocky River near Uralla, 1856; in beach sands at northern rivers, 1870; Gulgong, 1871; Mount Drysdale, 1892; Wyalong, 1893.

(ii.) *Victoria.* The first discovery of gold in Victoria was probably that made by the Hon. W. Campbell, at Clunes, in March, 1850. On the 5th July, 1851, notification was made of the discovery of gold in the Yarra Ranges by Mr. L. J. Nichel, and at the Pyrenees Mountains by Mr. James Esmond. Soon after the numerous fields near Mount Alexander were opened up. The chief centres of the gold-mining industry at the present time are in the Bendigo, Ballarat, Beechworth, Castlemaine, Maryborough, Gippsland, Ararat, and Stawell districts. In November, 1906, a remarkable discovery of gold was made near Tarnagulla, where a miner who had prospected the district for years obtained seven ounces of gold from a shaft nineteen feet deep, and some fairly large nuggets being found soon after, the so-called Poseidon rush set in. Several of the nuggets were unearthed within a few inches of the surface. The largest weighed 953 ounces and two others weighed 703 and 675 ounces respectively. The shallow ground was soon worked out, but operations have given satisfactory results in the deeper alluvial.

(iii.) *Queensland.* The first discovery of payable gold in Queensland was that made at Canoona by a party under the leadership of Mr. W. C. Capel. In 1863 gold was found at Canal Creek and Gladstone; Crocodile Creek field was discovered in 1865,

1. Figures for these years were given in "A Statistical Account of Australia and New Zealand for 1903-4" as 206,095; 404,889; 1,153,973 respectively, but those refer presumably to the enumerations in the earlier part of the years mentioned.

Ridglands in 1867, followed shortly afterwards by Rosewood and Gympie; Townsville was opened up in the following year, and the Gilbert River fields in 1869. Charters Towers dates from 1872; the Palmer goldfield from 1873; the Hodgkinson from 1875; while the celebrated Mount Morgan was first worked in 1882, Croydon in 1886, the Starcke field in 1890, Coen in 1900, and Alice River in 1904.

(iv.) *South Australia.* In South Australia, what is believed to have been the first authentic discovery of gold in the Commonwealth from which actual mining operations resulted was made in January, 1846, at a spot about ten miles east from the City of Adelaide. Although finds were subsequently made in many districts and over large areas, the gold-mining industry has never made very great progress in the State, and South Australia contributes the smallest share of the total gold production of the Commonwealth. There is, however, an immense area of country which has not been systematically prospected. There are numerous deposits of the precious metal at various localities in the Northern Territory, the total yield in 1908 being 8575 ounces, valued at £27,512, of which 1021 ounces were obtained at the Driffield. In June, 1909, a rich find of gold was reported from Tanami, about 200 miles from Hall's Creek and 450 miles to the south-east of Wyndham. Steps are being taken to open up this field by sinking wells to provide permanent water, of which there is a great scarcity in the district. A large number of Chinese are engaged in mining in the Territory. In 1908, out of a total of 824 miners employed, the Chinese numbered 674.

(v.) *Western Australia.* The discovery of gold in Western Australia took place at a much later date than in the eastern States; nevertheless the present production far exceeds in value that of any other portion of the continent. It appears that the precious metal was first detected in 1848, in specimens sent for assay to Adelaide from the Murchison copper and lead deposits. In 1852-53 rich specimens of gold-bearing stone were found by shepherds and others in the eastern districts, but they were unable afterwards to locate the places where the stone was discovered. The late Hon. A. C. Gregory found traces of gold in quartz in the Bowes River in 1854. In 1861 Mr. Panton found gold near Northam, while shortly afterwards a shepherd brought in rich specimens of auriferous quartz which he had found to the eastward of Northam, but he failed to locate the spot again. Various small finds were made up to 1882, when Mr. A. McRae, riding from Cossack to Roeburne, picked up a nugget weighing fourteen ounces. In 1885 Messrs. Hall, Slaterry, and others found gold on the Elvire, Margaret, and Ord Rivers. The Kimberley goldfield was opened in May, 1886. Next year the precious metal was discovered at Yilgarn, and the field was proclaimed in 1888, in which year rich finds were also made at Mallina and Pilbara Creek, the Pilbara field being proclaimed in October. The Ashburton and Yalgoo fields were proclaimed in 1890, and the Murchison in 1891. In 1892 Bayley and Ford discovered the Coolgardie field, obtaining over 500 ozs. of gold in one afternoon by the aid of a tomahawk. Alluvial was discovered by Frost and party at Goongarrie (the Ninety-mile) in May, 1893. Kalgoorlie (Hannan's) was discovered in June of the same year by Messrs. Flannigan and Hannan, Bardoc in August by Messrs. Cashman and Lee, Siberia by Frost and Bonner in October. There were numerous rich discoveries in 1894, such as at "Mount Jackson," "the Pinnacles," "Billy Billy," and at the celebrated Kanowna diggings. Rich finds were also made at Bulong, Londonderry, and the Wealth of Nations, Mr. J. D. Dunn, the discoverer of the latter, obtaining £20,000 of gold in a few days. The "Norseman" was discovered in July by Mr. L. Sinclair, as also the "Lady Shenton" at Menzies. The "Niagara" was discovered in January, 1895, also the rich field known as the "Hands Across the Sea," at Kunanalling. "Blackboy Hill" field was proclaimed in 1897, "Donnybrook" in 1898, while there were further rich finds in 1899.

(vi.) *Tasmania.* The first discovery of the precious metal in the island State is reported to have been made by a Mr. Riva, of Launceston, who is stated to have traced gold in slate rocks in the vicinity of Nine Mile Springs in 1849. A valuable discovery was made in 1852 at the Nook, near Fingal, and further small finds were reported during the same year from Tower Hill Creek and the vicinity of Nine Mile Springs (Lefroy). During 1859 the first quartz mine started operations at Fingal. In the same

year James Smith found gold at the River Forth, and Mr. Peter Leete at the Calder, a tributary of the Inglis. Reef gold was discovered in 1869 at Nine Mile Springs (Lefroy) by Mr. S. Richards. The first recorded returns from the Mangana goldfields date from 1870; Waterhouse, 1871; Hellyer, Denison, and Brandy Creek, 1872; Lisle, 1878; Gladstone and Cam, 1881; Minnow and River Forth, 1882; Branhholme and Mount Victoria, 1883; and Mount Lyell, 1886.

2. Production of Gold at Various Periods.—In the table hereunder 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.

VALUE OF GOLD RAISED IN AUSTRALIA, 1851 to 1908.

Year.	N.S.W.	Victoria.	Q'sland.	S.A.	W.A.	Tas.	C'wealth.
	£	£	£	£	£	£	£
1851 ...	468,336	851,506	...	...	...	...	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 ...	68,9174	12,214,976	...	8,800	...	...	12,812,950
1857 ...	674,477	11,320,852	...	876	...	...	11,696,205
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	8,140,602	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 ...	1,304,926	6,489,788	66,513	...	...	...	7,861,227
1865 ...	1,231,243	6,446,216	74,216	...	...	...	7,751,675
1866 ...	1,116,404	6,157,792	68,325	...	...	...	7,372,521
1867 ...	1,053,578	6,005,784	151,125	...	...	4,362	7,214,669
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	4,000	...	14,118	7,329,106
1872 ...	1,644,177	5,395,508	527,255	6,262	...	16,055	7,510,463
1873 ...	1,396,375	4,681,588	572,996	6,293	...	18,300	6,669,642
1874 ...	1,041,614	4,390,572	1,082,899	4,175	...	18,491	6,537,171
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	5,933,323
1877 ...	471,448	3,238,612	1,043,780	...	...	23,289	4,777,129
1878 ...	430,200	3,092,160	1,149,240	1,225	...	100,000	4,712,825
1879 ...	407,219	3,035,788	1,034,216	90	...	200,895	4,708,208
1880 ...	444,253	3,316,484	944,869	...	...	201,237	4,906,903
1881 ...	573,582	3,333,512	957,570	112,825	...	216,901	5,194,390
1882 ...	526,522	3,458,440	785,868	85,354	...	187,337	5,043,521
1883 ...	458,530	3,121,012	736,510	87,729	...	176,442	4,580,523
1884 ...	396,059	3,114,472	1,062,471	93,404	...	160,404	4,826,810
1885 ...	378,665	2,940,872	1,062,514	88,709	...	155,309	4,626,069
1886 ...	366,294	2,660,784	1,187,189	95,674	1,148	117,250	4,428,339
1887 ...	394,579	2,471,004	1,481,900	140,777	18,517	158,533	4,665,400
1888 ...	317,241	2,500,104	1,690,477	169,007	18,273	147,154	4,737,256
1889 ...	434,784	2,459,352	2,695,629	84,956	58,871	119,703	5,853,235
1890 ...	460,285	2,354,240	2,182,563	101,577	86,664	75,888	5,261,217
1891 ...	569,231	2,305,596	2,036,312	126,081	115,182	145,459	5,281,861
1892 ...	575,299	2,617,824	2,164,391	135,755	226,284	158,917	5,878,470
1893 ...	651,286	2,684,504	2,167,794	120,691	421,385	141,326	6,198,965
1894 ...	1,156,717	2,867,816	2,330,282	143,100	787,099	217,024	7,502,038
1895 ...	1,315,920	2,960,344	2,150,561	128,876	899,748	206,115	7,641,573
1896 ...	1,073,360	3,229,348	2,132,979	85,569	1,068,808	237,574	7,829,629
1897 ...	1,104,315	3,251,064	2,552,668	120,230	2,564,977	236,660	9,889,914
1898 ...	1,201,743	3,349,028	2,750,348	95,465	3,990,698	291,496	11,678,778
1899 ...	1,623,320	3,418,620	2,838,446	79,147	6,246,732	327,545	14,333,190
1900 ...	1,070,920	3,229,628	2,871,578	82,482	6,007,610	315,220	13,578,438
1901 ...	737,164	3,102,753	2,541,764	93,222	7,235,653	295,176	14,005,732
1902 ...	684,970	3,062,028	2,720,512	85,203	7,947,662	301,573	14,811,948
1903 ...	1,080,029	3,259,462	2,839,801	90,250	8,770,719	254,403	16,294,684
1904 ...	1,146,103	3,252,745	2,714,934	80,078	8,424,226	280,015	15,897,337
1905 ...	1,165,013	3,173,744	2,517,295	76,824	8,305,654	312,380	15,561,910
1906 ...	1,078,866	3,280,478	2,313,464	81,225	7,622,749	254,963	14,631,745
1907 ...	1,050,730	2,954,617	1,978,938	42,468	7,210,749	277,607	13,515,109
1908 ...	954,854	2,849,838	1,963,315	36,243	6,999,882	242,462	13,746,614
Total £	56,319,736	282,321,433	68,277,156	2,785,852	85,004,290	6,766,303	501,474,770

The following table shews the quantity in fine ounces of gold raised in each State and in the Commonwealth during each of the last eight years, the value of one ounce fine being £4 4s. 11½d.

QUANTITY OF GOLD PRODUCED IN THE COMMONWEALTH, 1901 to 1908.

Year.	N.S.W.	Victoria.	Queensland.	S. Aust.	W. Aust.	Tasmania.	C'wealth.
	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
1901	173,543	730,450	598,382	21,946	1,703,417	69,490	3,297,228
1902	161,256	720,863	640,463	22,413	1,871,039	70,996	3,487,030
1903	254,260	767,347	668,546	21,247	2,064,803	59,892	3,836,095
1904	269,817	765,596	639,150	18,835	1,983,230	65,921	3,742,549
1905	274,267	747,163	592,622	18,086	1,955,317	73,540	3,660,995
1906	253,937	772,291	544,636	19,122	1,794,548	60,023	3,444,607
1907	247,363	695,576	465,882	11,652	1,697,554	65,354	3,183,381
1908	224,792	670,909	462,204	8,532	1,647,912	57,085	3,071,434

3. Changes in Relative Positions of States as Gold Producers.—A glance at the figures in the preceding table 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. Victoria maintained its position as the chief gold-producer for a period of forty-seven years, or up to 1898, when its production was first outstripped by that of Western Australia, the latter State from this year onward contributing practically half the entire yield of the Commonwealth. New South Wales occupied the second place on the list until 1876, when Queensland returns exceeded those of the parent State, a condition of things that has been maintained ever since. Up to the year 1894 Tasmania and South Australia in turn occupied the position of lowest contributor to the total gold yield of the Commonwealth, but from 1894 onwards the returns from the former State have been in excess of those of the latter. Taking the average of the last eight years the relative positions of each State in regard to the gold production of the Commonwealth were as follows :—

RELATIVE POSITIONS OF STATES AS GOLD PRODUCERS, 1901 to 1908.

State.	Annual Average of Gold Production, 1901 to 1908.	Percentage on Commonwealth.	State.	Annual Average of Gold Production, 1901 to 1908.	Percentage on Commonwealth.
Commonwealth ...	£ 14,720,790	100.00	New South Wales	£ 986,216	6.71
Western Australia	7,814,662	53.07	Tasmania ...	277,336	1.88
Victoria ...	3,104,113	21.09	South Australia	74,430	0.51
Queensland ...	2,464,033	16.74			

4. Methods of Gold Mining adopted in Each State.—The circumstances of gold mining in the various States are not quite identical, for which reason reference is made to that of 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 times. The first of these deep alluvial leads was discovered at Forbes, in New South Wales, in 1862. The Tertiary deep leads at Gulgong were discovered in 1871. Cretaceous leads occur at Tibooburra, and detrital gold has been found in Permo-carboniferous conglomerates at Tallawang. The

method of dredging is at present being extensively used for winning gold from the beds of running streams, and also in 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 also employed 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 14,088 ozs. in 1908, the chief yields being—Braidwood, 1118 ozs.; Adelong, 1126 ozs.; Tumbarumba, 875 ozs.; and Orange, 852 ozs. The quantity obtained by dredging was 40,890 ozs.; the largest returns being obtained at Adelong, with 12,849 ozs.; Araluen, 12,560 ozs.; Stuart Town, 5956 ozs.; Wellington, 4181 ozs.; Nundle, 2045 ozs.; and Sofala, 1824 ozs. The dredges at work at the end of 1908 totalled 63, of which 24 were of the bucket type and 39 were pumping plants. The value of the plants in operation (including recovery plants) was estimated at £345,555. The quantity of gold won from quartz amounted to 175,619 ozs. At the present time the Cobar district is the chief centre of the production from quartz, the yields from the Canbelego and Cobar fields included therein being respectively 48,967 ozs. and 33,507 ozs. Next comes the Wyalong field, with 16,586 ozs.; Hillgrove, 12,607 ozs.; Murrumburrah, 12,061 ozs.; and Wellington, 8994 ozs.

The table below shews the yield from alluvial and quartz working in each of the principal districts during 1908 :—

***GOLD WON IN NEW SOUTH WALES, ALLUVIAL AND QUARTZ, 1908.**

District.	Alluvial.		Quartz.	Total
	Other than by Dredging.	By Dredging.		
	ozs.	ozs.	ozs.	ozs.
Bathurst	3,305	...	13,798	17,103
Cobar ... ..	...	...	82,648	82,648
Lachlan	466	...	32,739	33,205
Mudgee	1,741	4,181	16,065	21,987
Peel and Uralla	781	2,045	13,023	15,849
Southern	2,407	13,382	11,760	27,549
Tambaroora and Turon	1,248	8,119	1,219	10,586
Tumut and Adelong	3,342	13,148	1,889	18,379
Other districts	798	15	2,478	3,291
Total	14,088	40,890	175,619	230,597

* These particulars are based on information obtained locally, and the total of the quantities specified in this table does not agree with the total production as obtained from the Mint and from export and import returns and shewn on page 459.

(ii.) *Victoria.* Quartz-reefing 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 the two deepest shafts were at the 31st December, 1908, 4318 and 4300 feet deep respectively, while the bottom of the winze at the Victoria Reef Quartz was 4558 feet from the surface. Altogether there were at the close of 1908 no less than fifty-one 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, Castlemaine, and Ballarat districts, the number of plants in operation at the end of 1908 being 123, while 9 plants were in course of reconstruction or building. The total quantity of gold won from dredged mining in 1908 was 104,167 ounces, and from sluicing 1641 ounces. 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 follow :—

GOLD WON IN VICTORIA, ALLUVIAL AND QUARTZ, 1908.*

District.	Alluvial.	Quartz.	Total.
	ozs.	ozs.	ozs.
Ararat and Stawell	7,572	8,106	15,678
Ballarat	41,828	98,967	140,795
Beechworth	106,847	20,790	127,637
Bendigo	6,294	193,618	199,912
Castlemaine	31,968	52,092	84,060
Gippsland	7,360	58,656	66,016
Maryborough	47,855	27,365	75,220
Total	249,724	459,594	709,318

* As returned in crude ounces from chief mining districts.

(iii.) *Queensland.* Operations in Queensland are at present chiefly confined to quartz reefing, the yield from alluvial in 1908 being only 21,585 ounces, while the quantity produced from quartz was 350,995 ounces: from copper and other ores 87,928 ounces; and from old tailings 4577 ounces; making a total production of 465,085 ounces, valued at £1,975,554. The celebrated Mount Morgan mine occupies the position of being at the same time the most productive gold mine and the most productive copper mine in the State. The yields from the principal fields are given below :—

GOLD WON IN QUEENSLAND, ALLUVIAL AND QUARTZ, 1908.*

District.	Alluvial.	Quartz.	From Copper and other Ores and old Tailings.	Total.
	ozs.	ozs.	ozs.	ozs.
Charters Towers	646	157,935	3,689	162,270
Gympie	463	62,297	11	62,771
Mount Morgan	199	75,071	76,166	151,436
Ravenswood	563	35,243	...	35,806
Croydon	35	6,878	1,854	8,767
Clermont	4,137	326	...	4,463
Etheridge and Woolgar	13,066	4,356	242	17,664
Other districts	2,476	8,889	10,543	21,908
Total	21,585	350,995	92,505	465,085

* The figures given in this table are based upon returns obtained from the Mining Wardens, and the total production is somewhat in excess of that given by the Government Statistician.

(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. There are some valuable reefing fields in the Echunga district; at Mt. Grainger, Barossa, Wadnaminga, Mannahill, etc., but they have not been developed to the extent they deserve. Good stone was discovered a few years ago at Tarcoola, but the present returns are comparatively small. The rich finds at Arltunga in the centre of the continent, within the boundaries of the Northern Territory, have not yielded up to expectations, but the field has not been systematically prospected. It is stated that the gold occurs chiefly in vughs, crevices, and cellular quartz, the latter being at times exceedingly rich. The solid stone is low grade and is

not worked. Operations are confined to the vein matter, which is passed through screens, and the larger lumps hand picked, the fines and all that contains vughs or cellular quartz being saved for treatment and the balance discarded. South Australia is not divided into mining districts as is the case in the other States. The Macdonnell Ranges, although within the boundaries of the Northern Territory and coming under the operation of the Northern Territory Mining Act, yet geographically belong to South Australia proper. All business is done from Adelaide and the administration of the Mining Act south of the 19th parallel of latitude is conducted by the Hon. Minister controlling the Northern Territory, with the help of a resident warden at Arltunga. The total output of gold for 1908 from the Northern Territory amounted to 8575 ounces, valued at £27,512.

(v.) *Western Australia.* In Western Australia the operations are confined principally to quartz reefing, the returns from ordinary alluvial and hydraulic sluicing being comparatively small. The total production of gold from all sources during last year was 1,647,911 ounces, of which only 0.6 per cent. was alluvial. The production of gold on the various goldfields during the year 1908 was as follows:—

GOLD WON IN WESTERN AUSTRALIA, ALLUVIAL AND QUARTZ, 1908.

Goldfields.	Alluvial.	Dollied and Specimens.	Crushed.	Total.
	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
Peak Hill	106	266	7,608	7,980
East Murchison	352	165	144,276	144,793
Murchison	1,353	1,477	155,018	157,848
Mount Margaret	204	142	153,251	153,597
North Coolgardie	56	575	90,620	91,251
North-east Coolgardie	664	628	25,781	27,073
East Coolgardie	2,779	1,208	886,786	890,773
Coolgardie	113	483	39,433	40,029
Yilgarn ... ..	...	14	22,149	22,163
Dundas	16	710	27,918	28,644
Broad Arrow	607	278	17,545	18,430
Kimberley	91	...	59	150
Pilbara	1,635	77	5,253	6,965
West Pilbara	527	168	310	1,005
Phillips River	100	11	4,294	4,405
Other goldfields	189	314	481	984
Total	8,792	6,516	1,580,782	1,596,090

The figures in the above table are compiled from returns from the individual mines and are somewhat incomplete; the total is therefore less than the total shewn on page 489 from mint and export returns.

(vi.) *Tasmania.* The yield from Tasmania is also chiefly obtained from quartz reefing, although there is a little alluvial mining carried on in the Lyell district. The yields as returned from the chief centres in 1908 are shewn hereunder:—

GOLD WON IN TASMANIA, ALLUVIAL AND QUARTZ, 1908.

Description.	Northern & Southern.	North-eastern.	Eastern.	Western.	Total.
	ozs.	ozs.	ozs.	ozs.	ozs.
Quartz	31,202	117	3,583	22,008	56,910
Alluvial	298	353	...	79	730

The total production equalled 57,085 fine ounces, valued at £242,482. Bucket dredging is being carried on by three companies on the Ringarooma River; in 1908 these companies obtained 177 ounces of gold and 136 tons of tin ore, the number of men employed being 53.

5. Remarkable Masses of Gold.—The first "nugget" found in Australia was obtained at Hargraves, in New South Wales, on the 13th May, 1851, and weighed a little over 1 lb. In the same year the Burrandong nugget, found near Orange, weighed 2217 ozs. 16 dwts., and the "Brennan" was sold in Sydney for £1156. During the period 1880-82 nuggets weighing from 59 ozs. to 1393 ozs. were found at Temora. The "Jubilee," which weighed 347 ozs., was found in 1887.

In Victoria a nugget found at Canadian Gully in 1853 weighed 1620 ozs.; the "Welcome," found at Ballarat in 1858, weighed 2217 ozs.; and the "Welcome Stranger," unearthed in 1869 at Mount Moliagul, near Dunolly, weighed 2315 ozs., of which 2284 ozs. were fine gold and 31 ozs. silver, and was valued at £9534.

In addition to these alluvial nuggets large masses of gold have been found *in situ* in reefs. A mass known as "Kerr's Hundredweight," discovered in 1851 at Hargraves, in New South Wales, yielded 106 lbs. of gold. Probably the largest mass of gold ever found was obtained in Beyers and Holtermann's claim at Hill End in 1872. The total weight of the specimen, including the small amount of quartz in which it was encased, was 630 lbs. Its dimensions were 4 ft. 9 in. high, 2 ft. 2 in. wide, and about four inches thick. The value was not definitely known, but an offer of £13,000 was refused.

6. Modes of Occurrence of Gold in Australia.—(i.) *New South Wales.* The principal gold deposits worked with profit in New South Wales are classified by the Government Geologist of that State as follows:—(a) Alluvial or detrital gold. (b) Auriferous reefs or lodes. (c) Impregnations in stratified deposits, such as slate, quartzite, and volcanic tuff. (d) Impregnations in igneous rocks, such as granite, serpentine, felsite, etc. (e) Irregular deposits, such as bunches of auriferous ironstone. The detrital gold is found chiefly in Recent and Pleistocene alluvials, in beach sands along the coast, in Tertiary alluvial leads, in Cretaceous alluvial leads, and in Permo-carboniferous conglomerates. In the beach sands the gold is found in association with platinum and tin. In reefs the gangue is principally composed of quartz; calcide is often present, and barytes and fluor-spar are also met with. At Hill End gold was found associated with muscovite. In the oxidised portions of auriferous reefs, limonite, malachite, azurite, and cuprite are found, while below the water-line the veins are impregnated with iron pyrites, galena, copper pyrites, zinc blende, pyrrhotine, and stibnite. The auriferous quartz veins fall into three categories—fissure veins, bedded veins, and contact veins. Large masses of gold have occasionally been found in lodes, such as "Kerr's Hundredweight," alluded to in a preceding paragraph. The so-called saddle reefs in the Hargraves district are identical with those worked so profitably and at such great depths round Bendigo, in Victoria. Altogether gold has been found in association with over forty minerals in New South Wales, one of the most peculiar products being known as "mustard" gold, resultant on the decomposition of tellurides. The substance has the appearance of dull yellow clay, but it readily burnishes when pressed with a knife blade. Native gold has never been found in an absolutely pure state in New South Wales, being always alloyed with silver and also traces of other metals.

(ii.) *Victoria.* In Victoria the occurrence of gold is noted under two main headings—1. Matrix gold. 2. Redistributed gold. The so-called matrix gold occurs in quartz reefs of various kinds, in Ordovician, Silurian, and Lower Devonian sedimentary, metamorphic, and granitoid and porphyritic rocks; in reefs, veins, and lenticular deposits in dykes of granitoid, porphyritic, dioritic, and felspathic rocks, or between dykes and walls of intruded rocks; or in fracture planes or joints in granitoid rocks. Under the above conditions the gold is either free or in combination with iron, arsenic and iron, copper and iron, zinc, lead, antimony, silver, etc.

The redistributed gold is found in sands and gravels of existing streams, in deep leads, in littoral gravels and sands, and in cleavage and joint planes of rocks underlying the deep leads.

(iii.) *Queensland.* The most remarkable mode of occurrence in Queensland is that at the Mount Morgan mine, which presents so many novel features as to demand special reference. At this mine the siliceous material forming the ore body was found enclosed in igneous rock, which continued to the surface, except for a funnel-shaped mass of sandy beds and secondary ore outcropping near the summit of the mount. In a crevice of these sandy beds was deposited a plug of desert sandstone nearly 100 feet deep at its thickest part, with a surface area of three-fifths of an acre, quite distinct from and unconformable to, the beds of loose sand which underlay and surround it, and more ferruginous towards the outside than in the centre of its area. A ferruginous belt extended outside the plug, attaining a depth of 150 feet from the surface. It was hard and extremely rich in gold, which was disseminated through the stone in microscopic particles. Beneath the ironstone there was a band of loose sand or soft bed, in some places many feet in thickness, also extremely rich in gold. Underlying and almost surrounding the secondary ores, a great mass of siliceous and kaolin ore was found, denuded of its gold, which is supposed to have been leached out and conveyed in solution and again deposited in the enriched zone. The impoverishment prevails between the depths of 180 and 300 feet, the friable silicia being cellular from the removal of the pyrites. The evidences of the oxidation and leaching action are greater towards the centre than along the walls of the mass. Below the skeleton ore an unaltered zone of copper sulphide ore was found, in which gold was irregularly distributed; the copper increasing with the depth. Outside both sulphide and skeleton ore are walls of crystalline igneous rocks. Dykes, later than the massive igneous rocks but older than the enriched zone, traverse the siliceous sulphides in various directions. The theory advanced by Dr. Jack that the formations at Mount Morgan were due to geyser action at one time found wide acceptance, but later investigations tend to discredit it. So far, however, no completely satisfactory explanation has been put forward.

(iv.) *Western Australia.* The Government Geologist of Western Australia classifies the conditions under which gold is found in that State as follows:—(a) Native metal. (b) Compounds with tellurium and other elements. (c) Associated with other minerals.

Native gold occurs in several different forms, to which popular names descriptive of their appearance have been given, such as crystalline, dendritic, rough, flake, mustard, and sponge gold. Tellurides of gold abound at Kalgoorlie and Mulgabbie. Calverite is the most frequently occurring mineral, but petzite, goldschmidtite, and the minerals termed kalgoorite and coolgardite are also found. Of the metallic minerals, iron in the form of iron pyrites and oxides is widely distributed. Galena comes next, whilst amongst other minerals found in association with the precious metal may be mentioned zinc blende, arsenopyrite, vanadinite, bismuth pyrrhotite, chalcopyrite, bourononite, copper, scheelite. Quartz is of course the commonest of the earthy secondary minerals, but calcite, chalcedony, gypsum, actinolite, chlorite, and others are also found in association with gold. Some of the native gold is found to be remarkably pure, specimens of sponge gold from lodes at Boulder, Kalgoorlie, and East Coolgardie being found to contain 99.91 per cent. of the precious metal with but 0.09 per cent. of silver.

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 twelve years 1897 to 1908. The figures given in the table have been compiled chiefly from returns obtained direct by the Commonwealth Bureau of Census and Statistics from the gold-producing countries of the world.

WORLD'S GOLD PRODUCTION, 1897 to 1908.

Year.	World's Production of Gold.	Gold produced in Commonwealth.	Percentage of C'wealth on Total.
	£	£	%
1897 ...	48,196,000	9,890,000	20.52
1898 ...	58,136,000	11,679,000	20.09
1899 ...	63,015,000	14,533,000	23.06
1900 ...	51,515,000	13,578,000	26.36
1901 ...	53,544,000	14,006,000	26.16
1902 ...	60,869,000	14,812,000	24.33
1903 ...	66,650,000	16,295,000	24.45
1904 ...	70,688,000	15,897,000	22.49
1905 ...	76,675,000	15,551,000	20.28
1906 ...	82,569,000	14,632,000	17.72
1907 ...	84,904,000	13,515,000	15.92
1908* ...	91,450,000	13,059,000	14.28

* Partly estimated.

The latest published estimates place the world's gold yield at about 91½ millions sterling in 1908, towards which the Commonwealth contributed 13 millions, or about 14½ per cent. While the production of gold in the Commonwealth rose by about 32 per cent. in the twelve years from 1897 to 1908, the world's total increased by nearly 90 per cent. in the same period. The following table, will be found interesting as shewing the various foreign countries where the chief increases have taken place during the interval in question:—

INCREASE IN GOLD YIELD, VARIOUS COUNTRIES, 1897 to 1908.

Country.	1897.	1900.	1903	1907.	1908.*
	£	£	£	£	£
United States ...	11,787,000	16,269,000	15,122,000	18,583,000	19,566,000
Canada ...	1,240,000	5,742,000	3,877,000	1,725,000	2,025,000
Mexico ...	2,045,000	1,122,000	2,197,000	3,733,000	4,137,000
Transvaal ...	11,654,000	1,481,000	12,628,000	27,401,000	29,973,000
Rhodesia ...	800	308,000	828,000	2,179,000	2,526,000
Gold Coast ...	85,000	38,000	255,000	1,164,000	1,195,000
Madagascar ...	8,500	142,000	232,000	267,000	345,000
India ...	1,571,000	1,893,000	2,303,000	2,133,000	2,097,000
Korea ...	208,000	371,000	557,000	471,000	480,000
Japan ...	142,000	290,000	428,000	401,000	659,000
Java ...	24,000	100,000	280,000	479,000	610,000
Costa Rica ...	2,000	14,000	7,000	70,000	122,000

The largest increase was recorded in the Transvaal, where the production more than doubled itself in the five years 1903 to 1908.

The number of persons engaged in gold mining in each State during the last eight years is shewn in the following table. The figures for South Australia include 674 Chinese working on the fields in the Northern Territory.

PERSONS EMPLOYED IN GOLD MINING, 1901 to 1908.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Cwth.
	No.	No.	No.	No.	No.	No.	No.
1901	12,064	27,777	9,438	1,000	19,771	1,112	71,162
1902	10,610	26,151	9,045	1,000	20,476	1,038	68,320
1903	11,247	25,208	9,229	1,000	20,716	973	68,373
1904	10,648	24,331	9,620	1,000	18,804	1,076	65,479
1905	10,309	25,369	10,641	900	18,382	1,207	66,808
1906	8,816	25,304	9,842	900	17,926	988	63,776
1907	7,468	23,291	8,883	914	17,237	953	58,746
1908	6,363	20,853	8,515	1,213	16,075	953*	53,972†

* Figures for 1907; returns for 1908 not available. † Comprising Tasmanian returns for 1907.

§ 3. Platinum and the Platinoid Metals.

1. **Platinum.**—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 Fifield, near Parkes, but the entire production in 1908 was small, amounting to only 135 ozs., valued at £439, while the total production recorded to the end of 1908 amounted to 11,138 ozs., valued at £18,993. The matter of treating the extensive surface deposits received further attention during the year, but the difficulty of securing the necessary supply of water has not been surmounted.

In Victoria the metal has been found in association with copper at the Walhalla Copper Mine in Gippsland, but the mine is not at present being worked. The metal has also been found in small quantities in black sand beaches in the Otago district of New Zealand, and is present in the alluvial wash at Takaka, Nelson. Up to the present, however, the production has been trifling.

2. **Osmium, Iridium, etc.**—Small quantities of osmium, iridium, and rhodium are also found in various localities. As far back as 1860, the Rev. W. B. Clarke states 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.

In Victoria, iridesmine has been found near Foster, and at Waratah Range, South Gippsland.

§ 4. Silver.

1. **Discovery in Each State.**—(a) *New South Wales.* The occurrence of silver in New South Wales was first mentioned by Count Strzelecki in a letter addressed to Captain King, R.N., dated the 26th October, 1839. In his work, "The Southern Gold-fields," published in 1860, the Rev. W. B. Clarke also mentions a discovery of the metal. Since that date silver has been found in a large number of localities throughout the State. The Broken Hill field, the chief lode on which was discovered in 1882 by Mr. Charles Rasp, constitutes one of the richest and most productive mining centres in the world. Further reference to the production from the Broken Hill district will be made

on a subsequent page. Amongst other important finds in New South Wales may be mentioned Boorook, near Tenterfield, discovered in 1878; Sunny Corner, originally worked for gold in 1875; Emmaville, 1884; Rivertree, on the Clarence River, 1887; Borah Creek, near Inverell, 1870; Rockvale, 1895.

(b) *Victoria.* Mining for silver is not carried on to any extent in Victoria, the production recorded in the mining returns being chiefly obtained in the process of refining gold, and the same applies in the case of the production from Western Australia.

(c) *Queensland.* In Queensland most of the important gold mines yield also supplies of silver, but the credit of establishing the silver mining industry *per se* belongs to the Ravenswood field, where in 1879 the recovery of a parcel of 40 tons of galena assaying 130 ozs. of silver to the ton, marked the opening of the industry. At Chillagoe in 1884 there were thirty-two silver lead shows being worked, while during the decade 1885-1895 over 1½ million ozs. were raised at the Mount Albion mine. The Lady Jane and Girofla mines in the Mungana group at present are producing large supplies of silver lead ore of high grade. The Silver Spur mine at Texas produced £11,500 worth of silver lead in 1894, and the ore deposits in the vicinity are reckoned to be the richest in Southern Queensland. In 1908 the total quantity of silver produced in Queensland was 1,112,276 ozs., valued at £117,889.

(d) *South Australia.* In South Australia, silver lead is found in the main range, south of Adelaide. The Wheal Gawler mine, near Glen Osmond, opened in 1841, was probably the first mine worked in the Commonwealth. Silver lead deposits have also been noted north-east from Farina and west from Beltana. A small amount of silver lead is also obtained in the Northern Territory.

(e) *Tasmania.* Tasmania is the only State in the Commonwealth besides New South Wales which produces any considerable quantity of silver. The famous Zeehan mine, on the west coast, was discovered in 1885, and the deposits at Heazlewood River in 1887. Both districts are still opening up rich deposits of ore.

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, and 1901 to 1908:—

PRODUCTION OF SILVER AND LEAD, AUSTRALIA, 1881 to 1908.

Year.	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tasmania.	C'wealth.
	£	£	£	£	£	£	£
1881	...	5,239	13,494	1,182	11,224	...	31,139
1891	3,621,614	6,017	21,879	5,927	250	62,138	3,717,825
1901	1,954,964	6,550	69,234	3,886	7,718	325,335	2,367,687
1902	1,487,837	4,900	72,851	42,063	9,467	387,024	2,004,142
1903	1,539,989	4,898	109,177	10,870	19,153	428,125	2,112,212
1904	2,131,504	4,990	96,418	1,887	45,912	318,971	2,599,182
1905	2,496,709	4,100	102,888	3,244	44,278	415,248	3,065,967
1906	2,864,057	4,980	151,577	12,982	37,612	552,704	3,623,912
1907	4,290,128	4,355	187,870	13,873	26,674	572,560	5,095,460
1908	2,346,941	2,835	206,716	9,030	23,883	322,007	2,911,412

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 it is considered, therefore, that the State should not take full credit for the finished product. Hence the *net* value referred to above refers to that of the ore,

concentrates, and bullion, as declared by the several companies to the Customs Department at date of export. The real importance of the State as a producer of silver, lead, and zinc is thus to some extent lost sight of. The next table, however, which indicates the quantity and value of these metals locally produced, and the quantity and value of concentrates exported during the last five years, will shew the estimated total value of the yield:—

**VALUE OF PRODUCTION FROM SILVER-LEAD MINES OF NEW SOUTH WALES,
1904 TO 1908.**

Year.	Value of Silver, Lead, and Spelter produced within the C'wealth.	Value of Concentrates Exported.	Total.
	£	£	£
1904	2,088,784	642,125	2,730,909
1905	2,131,317	1,181,720	3,313,037
1906	2,112,977	1,876,834	3,989,811
1907	2,228,420	3,574,775	5,803,195
1908	2,008,410	2,400,997	4,409,407

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 1903 and during the last five years:—

**ESTIMATED QUANTITY AND VALUE OF SILVER YIELDED BY MINES OF NEW
SOUTH WALES, TO END OF 1908.**

Period.	Produced in Australia.		Contained in Concentrates, etc., Exported.		Total Production.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
To the end of 1903 ...	Fine ozs. 82,947,404	£ 13,807,421	Fine ozs. 104,659,834	£ 18,330,147	Fine ozs. 187,607,238	£ 32,137,568
1904	7,751,667	920,947	2,945,058	349,891	10,696,725	1,270,838
1905	6,804,934	852,533	3,480,561	436,050	10,285,495	1,288,583
1906	5,575,410	775,409	3,111,013	432,669	8,686,423	1,208,078
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	1,280,802
Total	115,485,160	17,845,326	125,924,072	20,982,370	241,409,232	38,827,696

The decrease in the value of the production for 1908 was chiefly due to the fact that operations in the Broken Hill field were conducted on a considerably restricted scale. The fall in the price of metals resulted in several of the mines in this field being closed down, while other mines curtailed development and productive work. The ore mined at the Broken Hill field was consequently 205,387 tons less than in the previous year, while the dividends paid dropped from £1,005,500 to £208,000. In Tasmania the decrease was principally owing to the temporary stoppage of the Tasmanian Smelting Company's works, followed by the closing down of the Magnet and Hercules mines. The output of the Yerranderie field in New South Wales, despite the adverse conditions obtaining, shewed an increase of £33,447 on the previous year.

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.* The bulk of the production is, of course, from New South Wales, being contributed mainly by the mines in the celebrated Broken Hill district.

At Broken Hill a considerable quantity of high-grade ore has been found at or near the surface, while shafts and drives have been put in along the lode to intersect ore bodies at greater depths. The deepest shaft on the field is on Block 10, where a depth of 1490 ft. has been reached, while shafts at the Proprietary and Junction North have been put down to a depth of 1300 and 1200 ft. respectively. Broken Hill itself consists of a low range about two miles in length, composed of crystalline gneisses passing into banded quartzites, micaceous and hornblendic schists, and garnetiferous sandstones. The rocks are bent into an anticlinal fold, the axis being coincident with the crown of the range, and the strata dipping away on each side almost parallel to the surface of the slope. The lode occupies the saddle-shaped cavity formed by the contortion of the strata, and its outcrop is coincident with the highest part of the range for about a mile and a half in length. Practically the whole of this outcrop has been removed in an open cut varying in width from 20 to 100 ft. The outcrop was composed of massive manganiferous limonite associated with siliceous and aluminous material, and containing numerous vughs bearing cerussite, chloride, iodide, and bromide of silver and stalactites of psilomelane. The iron ore contained from 2 to 30 ozs. of silver to the ton and from 10 to 25 per cent. of lead, and was extremely useful in fluxing the siliceous ores beneath it. Underneath the ironstone were found (1) deposits of carbonate of lead and a gangue composed of siliceous and aluminous material containing manganiferous iron oxide; (2) other high-grade ores containing kaolin, garnets, quartz with native silver, and also chlorides, chloro-bromides, and iodides, and yielding 4 to 300 ozs. of silver to the ton and a small quantity of lead; (3) a dry low-grade ore yielding from 5 to 40 ozs. to the ton. Below these so-called oxidised ores the lode consisted of rich sulphides containing galena, zinc blende, quartz, garnet, rhodonite, felspar, iron and copper pyrites, and small quantities of mispickel, wulfenite, and fluorspar. The sulphide ore contains from 6 to 36 ozs. of silver and 2 to 3 dwts. of gold to the ton, from 5 to 50 per cent. of lead, and 14 to 30 per cent. of zinc.

The gross value of the output of the mines in the Broken Hill division in 1908 was £3,215,325, as against £5,111,815 in the preceding year. The fall in metal values which set in towards the end of 1907 continued during the whole of 1908, and resulted in a general reduction in the number of hands employed, and, in the case of several of the mines along the line of lode, to an almost total cessation of operations. 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, 1908.

Mine.	Authorised Capital.	Value of Output to end of 1908.	Dividends and Bonuses Paid to end of 1908.
	£	£	£
Broken Hill Proprietary Co. Ltd. ...	384,000	32,013,972	9,752,000
Broken Hill Proprietary Block 14 Co. ...	155,000	3,189,484	443,827
British Broken Hill Proprietary Co. ...	264,000	1,993,616	337,500
Broken Hill Proprietary Block 10 Co. ...	1,000,000	3,423,861	1,175,000
Sulphide Corporation Ltd. (Central Mine) ...	1,100,000	8,848,941*	556,875
Broken Hill South Silver Mining Co. ...	200,000	2,995,000	595,000
North Broken Hill Mining Co. ...	140,000	886,893*	200,440
Broken Hill Junction Mining Co. ...	100,000	797,673*	85,000
Broken Hill Junction North Silver Mining Co. ...	180,000	540,912*	25,793
Broken Hill South Blocks Ltd. ...	200,000	288,456	...
Broken Hill South Extended Ltd. ...	337,500	150,344	50,000
Totals ...	4,060,500	55,129,152*	13,221,435

* Incomplete.

(b) *Yerranderie and Conrad Stannite.* The mines on the Yerranderie field in the Southern Mining District produced 828,129 ozs. of silver in 1908, besides small quantities of gold and lead. The total production was valued at £114,029, as compared with £80,582 in 1907. During 1908 the Conrad Stannite Mines Ltd., at Howell, in the Tingha Division, raised 22,427 tons of ore, but at these mines productive work was only carried on during the first seven months of the year, subsequent operations being confined to underground development.

(ii.) *Tasmania, West Coast.* The silver-lead mines on the west coast are now well established. Amongst the most important are the Mt. Zeehan, Zeehan-Montana, Zeehan-Western, Florence, Oonah, Silver Queen Extended, and South Comstock. The total production of silver-lead ore in 1908 was 63,167 tons, valued at £322,007, as against 89,762 tons, valued at £572,560, in 1907. The decrease is principally owing to the temporary stoppage of the Tasmanian Smelting Company's works, followed by the temporary closing down of the Magnet and Hercules mines.

(iii.) *Queensland.* In Queensland the two great Mungana mines, the Lady Jane and Girofla, produced in 1908, £29,927 worth of copper, £42,584 worth of silver, and £69,444 worth of lead. The Silver Spur mine at Texas produced £24,257 worth of metals, chiefly silver and lead. It is believed that silver lead will also prove an important factor in the development of the Etheridge goldfield.

The effect of the improved treatment of refractory ores is seen particularly in the returns for the Broken Hill district of New South Wales, where the export of zinc spelter and concentrates has increased from 97 tons, valued at £988, in 1889, to 276,720 tons, valued at £600,883, in 1908. In addition to the numerous plants for dealing with refractory ores on the fields itself, the Broken Hill Company possesses extensive smelting works at Port Pirie in South Australia. At Dapto and Cockle Creek in New South Wales there are also smelting establishments capable of dealing with considerable bodies of ore of various classes. The Tasmanian silver and lead ores are principally dealt with by the Tasmanian Smelting Company's works at Zeehan.

4. **World's Production of Silver.**—The world's production of silver during the last eight years is estimated to have been as follows:—

Year	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
World's production* in 1000 fine ozs.	174,851	163,937	173,222	176,840	181,338	184,552	183,386	200,655

* Add 000 to figures for fine ounces.

The Commonwealth's share in the world's silver production in 1908 was estimated at 15,677,000 ounces, or nearly 8 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 paid by the London Mint at various periods and during the last five years is given below.

PRICES OF SILVER, 1871 to 1908.

Year	1871.	1881.	1891.	1901.	1904.	1905.	1906.	1907.	1908.
Pence per standard oz. ...	60½	51½	45½	27½	26½	27½	30½	30½	24½

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 36½d.

6. **Employment in Silver Mining.**—The number of persons employed in silver mining during each year of the period 1901 to 1908 is given below :—

NUMBER OF PERSONS EMPLOYED IN SILVER MINING, 1901 to 1908.

Year.	N S.W.	Victoria.	Q'land.	S Aust.	W. Aust.	Tasmania	C'wealth.
	No.	No.	No.	No.	No.	No.	No.
1901 ...	6,298	...	40	150	...	2,414†	8,902§
1902 ...	5,382	...	100	150	...	2,893†	8,525§
1903 ...	6,035	...	458	150	...	1,681†	8,324§
1904 ...	7,071	...	45	50	...	1,101	8,267
1905 ...	7,887	...	293	50	...	1,512	9,742
1906 ...	9,414	13	282	50	...	1,745	11,504
1907 ...	10,021	10	785	86	8	1,908	12,818
1908 ...	7,560	3	496	51	5	1,908*	10,023†

* Figures for 1907; returns for 1908 not available. † Comprising Tasmanian returns for 1907.
 ‡ Including copper miners. § Including copper miners in Tasmania.

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. **History.**—(i.) *New South Wales.* It is believed that copper was the first metal mined for in New South Wales, the earliest attempts at working taking place about the year 1844. The deposits at Copper Hill, near Molong, were worked in 1845, as well as those in the neighbourhood of Canowindra. In 1847 mining for copper was commenced at the Summerhill Estate, near Rockley. The Rev. W. B. Clarke reported the discovery of copper ores near Marulan in 1851, and at Quidong, in the Snowy River district, in 1852. 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 of the Cobar district in 1908 was £347,429, out of a total for the State of £502,812. The Mount Hope field was opened in 1878, Nymagee in 1880, and Lake George in 1882.

At present, in addition to the yield from Cobar, good returns are being obtained at Mount Hope, at Cadia near Orange, at the Lloyd mine, Burruga, and at Cangai in the Grafton district.

(ii.) *Victoria.* In Victoria copper has been found at Bethanga, Sandy Creek, near Bogong, Walhalla on the Thomson River, and on the Snowy River and at Mount Tara near Buchan, but there are no mines at present being worked for their copper contents.

(iii.) *Queensland.* The first important discovery of copper in Queensland was made in the year 1862, when a rich lode was found near Clermont, on the Peak Downs. A further discovery was made during the same year at Mount Perry. Copper, tin, silver, and gold were found on the Herberton, Walsh, and Tinaroo mineral fields in 1879. The famous Mount Morgan, discovered in 1882, also produces a considerable amount of copper, the production therefrom in 1908 exceeding that from any other district. The production in 1908 from the more important districts was as follows :—Mount Morgan, £375,400; Herberton, £241,526; Mount Perry, £95,700; Cloncurry, £56,400; Rockhampton £50,500; Gladstone, £9900; the total quantity of copper produced in Queensland in that year being 14,698 tons, valued at £882,901.

(iv.) *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, Tasmania, Queensland, and New South Wales have come to the front as copper producers, as the table on the next page will

shew. Deposits of copper ore are found over a large portion of South Australia. The Kapunda mine, discovered in 1842 by Messrs. Dutton and Bagot, is situated fifty miles north of Adelaide, and is the oldest copper mine in the State. Up to the end of 1879 the production amounted to 70,000 tons, the metal possessing such a high standard of purity that it always obtained the highest prices in the world's markets. During the nine years 1870 to 1878 the production was valued at £157,000. The Burra Burra mine, located in 1845 by a shepherd named Pickett, is situated about 100 miles north of Adelaide. The original capital invested in this mine was £12,320 in £5 shares, on which no call was ever made, while dividends to the amount of £800,000 were paid. For many years this mine produced from 10,000 to 13,000 tons of ore, averaging 22 to 23 per cent. of copper. During the 29½ years in which the mine was worked the production was valued at £4,749,000. In 1859 as many as 1170 persons were employed on it. The mine has lain practically idle for many years, but recently there have been attempts at re-working.

Yorke's Peninsula, between Spencer's Gulf and St. Vincent's Gulf, contains a large area of copper-bearing country. The principal mines at Wallaroo and Moonta are situated a few miles from Port Wallaroo, and date back to 1860. For about thirty years the Moonta mines were worked independently, selling their ores to the Wallaroo company. During its separate existence the Wallaroo field produced about £2,600,000 worth of copper, while Moonta yielded £5,396,000, and was the first Australian mining field to produce £1,000,000 in dividends. The amalgamation took place in 1889, and since that year the united properties have produced about £4,281,000 worth of copper. The entire yield from the date of first working is estimated at about £12,500,000. The mines just enumerated represent a very small proportion only of those opened on the copper-bearing areas of the State. Owing to the depression in the price of copper in 1908 many promising mines in South Australia suspended working and in others operations were much curtailed. Developmental and other work is proceeding at Yudnamutana, Mutooroo, Callington, and other places.

Copper is also obtained in the Northern Territory; the actual output of ore for the year, however, was only a little over £3000 in value. This poor result was entirely due to the low prices and high cartage rates from outlying fields from which, in the main, copper is produced.

(v.) *Western Australia.* The inception of active mining operations in Western Australia dates from the year 1842, when lead and copper mines were discovered in the Northampton district, but working was carried on in a most perfunctory manner in the early days, sinking being discontinued as soon as the lodes shewed signs of contraction. Rich ores of copper have been located at Whim Creek, in the Pilbara district, about fifty miles eastward of Roeburne, the copper ore being removed by quarrying. Promising lodes have also been struck at the Irwin mines, between Arrino Springs and the Irwin River. The Kimberley district is intersected in places by copper and lead deposits in association with gold, and a rich lode has been located at Mount Barren, about 120 miles to the eastward of Albany, while various quartz reefs in the Wongan Hills contain copper in association with gold and iron. The largest producer in 1908 was the Mount Morgans district of the Mount Margaret goldfield, the production from that district being 4404 tons copper ore, and 668 tons of copper, valued at £20,221. The West Pilbara field yielded £17,691 worth of copper ore in 1908. The Phillips River fields shewed a total output of £9233.

(vi.) *Tasmania.* For a long time Tasmania was the largest producer of copper in the Commonwealth, but during the last two years Queensland has occupied the premier position. The cupriferous area in the island State stretches from Mount Lyell, Mount Tyndall, Mount Read, and Mount Murchison, in the western district, to some distance north of the Pieman River. Copper mining has also been started on the North-west Coast, notably in the Stowport and Blythe River districts, and some attention has been given to the deposits at Rocky Cape and Boat Harbour. In 1908 the output of the Mount Lyell Mining and Railway Co. Ltd. was 8833 tons of blister copper, which con-

tained copper valued at £533,026, silver £70,036, and gold £78,009. This company during the year paid £210,000 in dividends. A new copper field at Mount Balfour is attracting considerable attention. A number of sections have been taken up and are being systematically prospected.

2. Production of Copper.—The production of copper in the various States of the Commonwealth has been influenced considerably by the ruling prices, which have fluctuated in an extraordinary way. In 1908 the ruling price of the metal remained so consistently low that the progress of operations was seriously affected, and companies, which in previous years were important producers, found that they were unable to adjust their economies to suit the conditions, and were compelled to suspend work. The quantity and value of the production in earlier years and for 1904 to 1908 is shewn in the following tables :—

PRODUCTION OF COPPER, AUSTRALIA, 1881 to 1908.

State.	1881.	1891.	1901.	1904.	1905.	1906.	1907.	1908.
QUANTITY.								
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
N.S.W. ... { Copper	*	*	6,067	6,501	7,962	8,964	8,963	8,679
{ Ore	*	*	645	2,435	630	791	1,135	392
Victoria... { Copper	*	*	...	...	...	...	38	983
{ & Ore	*	*	...	...	...	...	12,756	14,961
Q'land ... { Copper	330	85	3,061	4,370	7,221	10,077	8,406	8,763
S. Aust. ... { Ore	3,824	3,551	6,736	9,056	11,100	8,406	8,763	6,152
{ Ore	21,638	13,239	2,353	...	...	527	...	479
W. Aust. ... { Copper	...	*	10,157	3,969	2,389	7,430	3,727	2,503
{ Ore	...	...	9,730	9,351	8,558	8,613	9,035	8,833
Tasmania { Copper	...	...	10,029	25	4,016	2,235	...	1,185
{ Ore	...	...	...	...	...	...	...	...
C'wealth { Copper	...	...	25,614	29,278	34,841	36,060	46,019	44,167
{ Ore	...	...	23,184	6,429	7,035	10,983	...	...
VALUE.								
	£	£	£	£	£	£	£	£
New South Wales...	227,667	119,195	412,292	406,001	527,403	789,527	727,774	502,812
Victoria ...	8,186	216	...	...	...	...	2,356	3,928
Queensland ...	19,637	3,554	194,227	257,896	503,547	916,546	1,028,179	893,535
South Australia ...	418,296	235,317	500,077	438,960	483,431	743,671	708,031	345,968
Western Australia	...	4,463	75,246	25,180	16,266	50,337	203,376	57,091
Tasmania ...	...	...	1,026,748	569,053	563,275	844,663	869,665	609,651
Commonwealth ...	673,786	362,745	2,208,590	1,697,090	2,093,922	3,344,744	3,536,382	2,412,985

* Not available.

3. Price of Copper.—The great variation in price that the metal has undergone is shewn in the following table of prices realised for standard and best selected copper since 1897 :—

FLUCTUATION IN THE VALUE OF COPPER, 1897 to 1908.

Year.	Average Price of Copper per Ton.		Year.	Average Price of Copper per Ton.	
	Standard.	Best Selected.		Standard.	Best Selected.
	£ s. d.	£ s. d.		£ s. d.	£ s. d.
1897	49 2 6	52 5 6	1905—Jan. to June	67 2 1	71 3 9
1898	51 16 7	55 8 3	July to Dec.	72 1 11	77 7 11
1899	73 13 9	78 2 3	1906—Jan. to June	82 2 8	86 18 11
1900	73 2 5	78 9 1	July to Dec.	92 15 1	97 11 1
1901	66 19 1	73 8 2	1907—Jan. to June	103 4 4	111 8 4
1902	52 8 3	56 12 7	July to Dec.	70 18 10	76 0 6
1903	58 3 2	62 13 8	1908—Jan. to June	59 0 9	62 5 10
1904	59 0 7	62 13 0	July to Dec.	61 1 0	64 4 3

There is no doubt that the steady rise in the price of copper from the year 1902 onwards caused a large amount of overtrading with consequent unhealthy inflation of values, while the sudden drop in 1907 was directly due to the financial panic in America. It is believed, however, that the increasing demand for the metal in electrical and other industries will, under ordinary circumstances, tend to establish prices on a sounder basis, and at higher rates than those quoted for the last twelve months in the table above.

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

WORLD'S PRODUCTION OF COPPER, 1901 to 1908.

Year ...	1901.	1904.	1905.	1906.*	1907	1908.
World's production (short tons) ...	583,517	764,758	770,221	788,492	796,366	839,846

Of the total production last year the share of the Commonwealth amounted to about 5½ per cent.

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

PERSONS ENGAGED IN COPPER MINING, 1901 to 1908.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tasmania.	C'wealth.
	No.	No.	No.	No.	No.	No.	No.
1901 ...	2,964	4	814	4,000	321	*	8,103§
1902 ...	1,699	...	666	4,000	113	*	6,478§
1903 ...	1,816	...	1,418	4,000	193	*	7,427§
1904 ...	1,850	...	1,094	4,000	169	925	8,038
1905 ...	2,171	...	1,435	4,500	125	2,269	10,500
1906 ...	3,047	3	2,598	5,000	296	2,391	13,335
1907 ...	3,764	10	3,941	5,254	611	2,614	16,194
1908 ...	2,745	9	3,540	4,558	283	2,614†	13,749†

* Included with silver miners. † Figures for 1907; returns for 1908 not being available.
‡ Comprising Tasmanian returns for 1907. § Excluding Tasmania.

§ 6. Tin.

1. **History.**—(i.) *New South Wales.* The probable occurrence of tin in New South Wales was first referred to by the Rev. W. B. Clarke as early as 1849, while the same author notes having obtained a specimen in the Kosciusko district in 1851 and in the New England district in 1853. He also reported the discovery of stanniferous deposits at different localities in the Darling Downs, Queensland. In 1872 the Messrs. Fearby discovered tinstone near Inverell, and the present Elsmore mine was opened near the spot. The news of the discovery of tin in the New England district attracted a mild rush, and in March, 1872, valuable deposits of stream tin were found at Vegetable Creek. It is interesting to note that native tin, which is extremely rare, was discovered at Oban, in this district. At Cope's Creek stanniferous gravels occur in the channel of the stream and in the slopes adjacent to it. Post-tertiary deposits of tin-bearing ore have been found at Emmaville, where mining was commenced soon after the opening of the district. In the southern portion of the State deposits have been discovered at Dora Dora, near Albury, and Pulletop, near Wagga, in the central-western district at Burra Burra, near

Parkes, and in the far west at Poolamacca and Euriowie. The bulk of the yield, however still comes from the Tingha-Inverell district, the production last year being £117,600, out of a total for the whole State of £205,447. Of the total production in 1908 £129,952, or 60 per cent., represents the value obtained by dredging. During the year the Sydney Smelting Company at Woolwich dealt with 1500 tons of ore obtained from the tin-fields of the State, the value of the product being estimated at £185,460.

(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 last year was obtained by dredging and hydraulic sluicing, the chief yields being 39 tons of ore, valued at £3289, raised in the Beechworth district, and 23 tons, valued at £1555, raised at Toora.

(iii.) *Queensland.* The first notable discovery of the metal in Queensland occurred in 1872, when rich deposits of stream tin were found in the country to the south of Warwick and on the borders of New South Wales. This district proved to be surprisingly rich, the value of the metal raised there during the five years subsequent to its discovery being £715,000. The alluvial deposits, however, soon became exhausted, so far as the ordinary miner is concerned, but some degree of success has attended dredging operations in the district. In 1879 important discoveries were made in the Herbert River district, and the rich Herberton, Walsh, and Tinaroo mineral fields were opened up, further discoveries being shortly after reported on the Russell, Mulgrave, Jordan, and Johnstone. At the Annan River tinfield, near Cooktown, alluvial mining has been carried on continuously since 1886. The production in 1908 amounted to 4825 tons, valued at £342,191, more than three-fourths of which were produced by the Herberton mineral field.

(iv.) *Northern Territory.* Valuable lodes of tin are found in the Northern Territory at Mount Wells, West Arm and Bynoe Harbour, and at Horseshoe Creek, south of Pine Creek, but the deposits have not yet been exploited to the extent they deserve. In 1908 there were 304 miners engaged in tin mining in the Northern Territory and the quantity of tin ores and concentrates exported was 447 tons, the highest yet recorded. This increase was entirely due to the progress at the Mount Wells mine, where, it is stated, there are enormous bodies of payable material awaiting development.

The metal has also been discovered near Earea Dam in the province proper.

(v.) *Western Australia.* Tin was first discovered in Western Australia in the year 1888, and since that date has been found in several widely distant localities in the State—at the head of the Bow and Lennard Rivers, in the Kimberley district; on the Thomas River, Gascoyne goldfield; at Brockman's Soak and the Western Shaw, in the Pilbara district; and at Greenbushes, in the south-western portion of the State. The production of tin ore and ingot for the State during 1908 amounted to 1093 tons, valued at £83,295, to which the Greenbushes field contributed 576 tons, valued at £41,046, and Pilbara 403 tons, valued at £30,636. Lode tin has been discovered at Wodgina, in the Pilbara field, and the deposits are being developed.

(vi.) *Tasmania.* Tin mining in Tasmania dates from the year 1871, when the celebrated Mount Bischoff mine was discovered by Mr. James Smith. This mine, which is probably the richest in existence, is worked as an open quarry, and a large proportion of the original hill has been removed in the course of developmental operations. Soon after rich deposits were located in the north-east district by Mr. G. B. Bell, while deposits of stream tin were discovered near St. Helens by Messrs. Wintle and Hunt. Further finds were reported from Flinders and Cape Barren Islands, and in 1875 the metal was discovered at Mount Heemskirk. The total production of Tasmania in 1908 was 4521 tons of ore, valued at £421,580, the largest producer being the Briseis Tin Mines Limited, in the North-east division, with a return of 1047 tons. This company distributed during the year £60,000 in dividends. The Mount Bischoff mine paid dividends amounting to

£36,000, making a total to the end of 1908 of £2,160,000. Good returns are being obtained at the North-East Dundas and at Mount Heemskirk, and a fair amount of alluvial is furnished by the Eastern mining division. Other mines in the Western division are being prospected, and it is stated that some very rich deposits have been discovered.

2. Value of Tin Produced.—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 shews the production in each of the Commonwealth States during the years 1881, 1891, 1901, and 1904 to 1908:—

TIN PRODUCED IN AUSTRALIA, 1881 to 1908.

State.	1881.	1891.	1901.	1904.	1905.	1906.	1907.	1908.
QUANTITY.								
New South Wales	Ingots 5,824 Ore 609	Ingots 1,454 Ore 203	Ingots 648 Ore 11	Ingots 1,074 Ore 626	Ingots 1,170 Ore 786	Ingots 1,161 Ore 510	Ingots 1,331 Ore 583	Ingots 954 Ore 841
Victoria ...	Ore †	Ore †	Ore 77	Ore 71	Ore 124	Ore 106	Ore 104	Ore 79
Queensland*	Ore †	Ore †	Ore 1,661	Ore 3,923	Ore 3,945	Ore 4,823	Ore 5,140	Ore 4,885
South Australia	Ore †	Ore †	Ore 81	Ore 300	Ore 235	Ore 398	Ore 436	Ore 441
West Australia	Black tin ...	Black tin ...	Ore 734	Ore 855	Ore 1,079	Ore 1,495	Ore 1,502†	Ore 1,068†
Tasmania ...	Ore †	Ore †	Ore 1,790	Ore 2,172	Ore 3,892	Ore 4,473	Ore 4,343	Ore 4,521
Commonwealth	Ingots, ore, etc. †	Ingots, ore, etc. †	Ore 5,002	Ore 9,021	Ore 11,291	Ore 12,966	Ore 13,439	Ore 12,814
VALUE.								
New South Wales...	Ingots £531,303 Ore £37,492	Ingots £124,320 Ore £9,643	Ingots £76,080 Ore £464	Ingots £138,681 Ore £49,496	Ingots £163,505 Ore £62,515	Ingots £205,373 Ore £60,371	Ingots £229,607 Ore £63,698	Ingots £126,292 Ore £79,155
Victoria ...	Ore £7,334	Ore £5,092	Ore £4,181	Ore £5,190	Ore £11,159	Ore £11,644	Ore £10,531	Ore £6,070
Queensland ...	Ore £193,699	Ore £116,387	Ore £93,723	Ore £270,276	Ore £297,454	Ore £490,283	Ore £496,766	Ore £341,566
South Australia ...	Ore ...	Ore £1,938	Ore £5,586	Ore £24,179	Ore £23,768	Ore £36,907	Ore £41,365	Ore £35,876
West Australia	Black tin ...	Ore £10,200	Ore £40,000	Ore £58,817	Ore £86,840	Ore £157,644	Ore £166,139	Ore £83,595
Tasmania ...	Ore £375,775	Ore £293,170	Ore £212,542	Ore £255,228	Ore £362,670	Ore £557,266	Ore £501,681	Ore £421,580
Commonwealth	... £1,145,603	... £560,750	... £432,576	... £802,067	... £1,008,001	... £1,509,488	... £1,509,787	... £1,094,134

* Dressed tin ore, about 70% tin. † Tin ingot and ore. ‡ Not available.

3. World's Production of Tin.—According to "The Mineral Industry" the world's supplies of tin during each of the last five years were obtained as follows:—

THE WORLD'S TIN SUPPLIES, 1904 to 1908.

Origin.	1904.	1905.	1906.	1907.	1908.
English production ...	Tons. 4,132	Tons. 4,468	Tons. 4,522	Tons. 4,700	Tons. 4,650
Chinese exports ...	...	4,482	4,052	4,000	4,000
Straits to Europe and America ...	57,419	56,840	57,143	52,520	60,463
Straits to India and China ...	3,261	1,484	1,292	3,140	2,190
Australia to Europe and America ...	4,846	5,028	6,482	6,612	5,921
Banka sales in Holland ...	11,363	9,960	9,286	11,264	} 13,900
Billiton sales in Java and Holland ...	3,215	2,715	1,968	2,229	
Bolivian arrivals on Continent ...	} 12,978	14,245	16,394	15,500	17,000
Bolivian arrivals in England ...					
Total (long tons) ...	97,214	99,222	101,139	99,965	108,124

The main users of tin are the manufacturers of tin-plates, while it is also required in conjunction with other metals to produce bronze, brass, Britannia metal, pewter,

printers' type, and solder. It is stated that the rising tendency of prices during recent years is due to the fact that production has not been commensurate with the demands for consumption, and also in some measure to the fact that for industrial purposes the metal can be replaced by others to a limited extent only.

4. **Prices of Tin.**—The average price of the metal in the London market for the year 1897 and from 1901 to 1908 was as follows:—

PRICE PER TON OF TIN, 1897 to 1908.

Year.	Price per Ton.	Year.	Price per Ton.
	£ s. d.		£ s. d.
1897	61 8 0	1905	143 1 8
1901	118 12 8	1906	180 12 11
1902	120 14 5	1907	172 12 9
1903	127 6 5	1908	133 2 6
1904	126 14 8		

According to "The Mineral Industry" the maximum price obtained for tin during the period 1897-1908 was reached in December, 1906, when the metal was quoted at £195 19s. 9d. per ton.

5. **Employment in Tin Mining.**—The number of persons employed in tin mining during each of the years 1901 to 1908 is shewn below:—

PERSONS ENGAGED IN TIN MINING, 1901 to 1908.

Year.	N.S.W.	Victoria.	Qld.	S. Aust.	W. Aust.	Tas.	Cwlth.
	No.	No.	No.	No.	No.	No.	No.
1901	1,428	...	1,148	...	413	1,065	4,054
1902	1,288	...	1,467	...	249	1,260	4,264
1903	2,502	...	1,598	...	294	1,331	5,725
1904	2,745	50	2,237	...	284	1,304	6,620
1905	2,884	50	2,936	...	479	1,351	7,700
1906	3,795	95	2,872	...	890	1,659	9,811
1907	3,173	87	2,582	554	1,003	1,828	9,227
1908	2,456	53	2,140	384	614	1,828*	7,475†

* Figures for 1907; returns for 1908 not available. † Comprising Tasmanian returns for 1907.

§ 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.

Improvements in means of extracting zinc concentrates from the tailings of certain Broken Hill mines have led to a largely increased production in recent years, as the following table shews:—

NEW SOUTH WALES.—PRODUCTION OF ZINC, 1889 to 1908.

Year.	Quantity of Zinc (Spelter and Concentrates) Produced.	Value.	Year.	Quantity of Zinc (Spelter and Concentrates) Produced.	Value.
	Tons.	£		Tons.	£
1889	97	988	1906	103,666	292,806
1891	219	2,622	1907	237,219	536,620
1899	49,879	49,207	1908	276,720	600,883

The total quantity of zinc (spelter and concentrates) produced in New South Wales to the end of the year 1908 was 940,288 tons, valued at £2,027,777. The average price of spelter per ton in the London market during each of the last four years was £25 7s. 7d. in 1905, £27 1s. 5d. in 1906, £23 16s. 9d. in 1907, and £20 3s. 5½d. in 1908.

§ 8. Iron.

1. **General.**—The fact that iron-ore is widely distributed throughout the Commonwealth has long been known, and extensive deposits have been discovered from time to time at various places in New South Wales, Queensland, South Australia, Western Australia, and Tasmania. It will appear, however, from what is stated below that until quite recently but little has been done in the way of converting these deposits into a marketable commodity.

(i.) *The Manufacturers' Encouragement Act 1908.* It is hoped that the passing by the Commonwealth Parliament of the Manufacturers' Encouragement Act, which was assented to on the 14th December, 1908, will 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. Judging by the increased activity and output already manifested at the iron works at Lithgow, in New South Wales, it would appear that there are reasonable prospects of these hopes being realised in the near future. The Act referred to provides for the payment of a bounty not exceeding £30,000 per annum on all pig iron, puddled bar iron and steel, made from Australian ore and pig iron respectively, on the following basis :—

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

Description of Goods.	Rate of Bounty.	Total Amount which may be authorised.	Date of Expiry of Bounty.
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	"		

The Act also provides for the payment of bounties on galvanised sheet or plate iron or steel, on wire and wire netting, and on iron or steel tubes or pipes.

2. **History.**—(i.) *New South Wales.* The existence of large deposits of iron ore in New South Wales has been known since the early years of the history of the State, but until quite recently little was accomplished in the way of utilising these deposits so as to produce any extensive supply of marketable metal. According to a report furnished by the Government Geologist in 1905, the total quantity of ore available for exploitation is 53,000,000 tons, the deposits at Cadia, near Orange, being computed to contain no less than 39,000,000 tons, of which a large proportion consists of ores capable of yielding a high-grade metal. The aluminous ores at Wingello are estimated to contain 3,000,000 tons, the titaniferous magnetic ores on the Williams and Karuah Rivers nearly 2,000,000 tons, the hematite and brown ores at Carcoar, 3,000,000 tons; while several other districts are capable of supplying over 1,000,000 tons. There are extensive supplies of coal and limestone within reasonable distance of some of the more extensive deposits. The increasing demand for iron and steel manufactures and the enhanced price of the metal, will probably enable the State in the near future to take its place amongst the iron-producing countries of the world. Ironworks were established at Fitzroy, near Mittagong, as far back as 1852, and at Eskbank, near Lithgow, in 1875, but the production of pig iron and manufactures was in neither case considerable. In May, 1907,

however, works on a much larger scale were opened at Lithgow, and in January, 1908, they were taken over by the firm of G. and C. Hoskins (Limited). Work was interrupted for some weeks in 1908 owing to a dispute with the men respecting wages, and during this period the opportunity was taken to make considerable additions and alterations to the plant, rolling mills, etc., with the object of increasing the output. The ironstone used in this establishment was obtained at Carcoar, where the deposit is calculated to yield 2000 tons of ore for a period of twenty-five years. During 1908 the ore raised amounted to 51,206 tons. The following materials were also received at the blast furnace:—Limestone, 22,467 tons; coke, 36,134 tons; and slag, 5637 tons. The output was 30,393 tons of pig iron, valued at £98,777. In addition the iron and steel, bars, castings, etc., made from scrap, were valued at £19,447, while 3946 tons of steel ingots, valued at £21,703, were also manufactured. The mine and works employed 632 hands, and the wages paid amounted to £74,472. The following table shews the quantity and value of finished iron, pig iron, etc., made in New South Wales during the last five years, chiefly from scrap iron, but partly from the smelting of iron ore:—

NEW SOUTH WALES—PRODUCTION OF IRON, 1904 to 1908.

Particulars.				1904.	1905.	1906.	1907.*	1908.†
Quantity	...	...	Tons	6,303	4,447	8,000	29,902	40,207
Value	...	...	£	80,504	85,693	112,848	178,632	118,224

* Includes 18,631 tons pig iron, valued at £60,550, produced from 34,500 tons of iron ore raised within the State. † Includes 30,393 tons pig iron, valued at £98,777, from 51,206 tons of ore raised within the State.

A quantity of iron oxide is purchased by the various gasworks for use in purifying gas, the output in New South Wales being drawn from the deposits at Port Macquarie and Mittagong. During 1908 the quantity raised was 1827 tons, valued at £1857, while the total output to the end of that year was 12,102 tons, valued at £17,945. The quantity of ironstone disposed of for flux in New South Wales during 1908 exhibits a decrease, since the requirements of the smelting companies were diminished. In 1908 the quantity raised was 8087 tons, valued at £6199, as against 10,659 tons, valued at £7707, in the preceding year.

(ii.) *Victoria.* Iron ore has been located at various places in Victoria, particularly at Nowa Nowa, in the Gippsland district, and at Dookie. 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 cheaply 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 1908, 48,047 tons of ironstone were procured at Iron Island in the Rockhampton district, to be used as fluxes at the Mount Morgan mine.

(iv.) *South Australia.* In South Australia iron ore is raised for fluxing purposes only, although the State possesses some rich deposits 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. This property has been leased by the Broken Hill Proprietary Company, the ore being transported to the smelting works at Port Pirie. Extensive beds of limonite with a little hematite are found at Cutaña, near Mingary, and it was from this district that the Broken Hill Company at one time obtained ore for fluxing purposes. At Mount Jagged, where a small quantity of pig iron was made about thirty-five years ago, there are large deposits of hematite. Ore beds of varying extent have been located at Peralilla, near Port Victor, at Oodla Wirra, at Donnelly's, near Quorn, and several other localities.

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

(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. It is proposed to work the deposits on Koolan Island at Yampi Sound with a view to exporting the ore for fluxing purposes in connection with the Mount Morgan gold mines, Queensland.

(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 mines at Penguin.

(vii.) *World's Production of Iron, 1908.* The quantity of iron produced in Australia is but a very small proportion of the world's production, which in 1908 amounted to 48,180,000 tons (pig iron). The leading position for magnitude of production is held by the United States, which in 1908 produced 15,936,018 tons, compared with Germany's 11,813,511 tons, and Great Britain's 9,289,840 tons. The position of the three countries named is similar to what it has been for several years past.

§ 9. Other Metals.

1. **Aluminium.**—In the form of bauxite or hydrous sesquioxide, aluminium is found in New South Wales at Emmaville, Inverell, and Wingello, its existence being first recognised in 1889. The metal, however, has not been manufactured locally.

2. **Antimony.**—This metal is widely distributed in New South Wales, and has been found native at Lucknow, near Orange. Dyscrasite, a silver antimonide, has been found in masses up to one ton in weight in the Broken Hill lodes. It has also been found at various places in Victoria, chiefly in association with gold. In 1907 the export of antimony metal and ore from New South Wales amounted to £46,278, and in 1908 to £1141, but in the latter year a quantity of ore was raised but was not disposed of. The chief production in 1908 was from the Hillgrove district, where it is estimated that 286 tons of ore, valued at £2100, were mined, but only 117 tons, valued at £1141, were exported. The production of antimony ore in Victoria during 1908 amounted to 3679 tons, valued at £10,428. The ore was raised by a syndicate 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. The total yield in Queensland in 1908, however, was only 42 tons, valued at £469. It is stated that there is a prospect of increased production at the Mitchell River deposits, where an elaborate plant has recently been erected. The low price of antimony throughout the year 1908 to a large extent restrained further developmental work. In Western Australia good lodes of stibnite, carrying gold, have been found in the Roeburne district.

3. **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.

4. **Barium.**—A valuable lode of barium sulphate has been discovered near Dalwin, on the North Lyell railway, in Tasmania, and the necessary plant is in course of erection to develop the deposit. It is stated that the lode is from $2\frac{1}{2}$ to 7 feet wide over a length of over 40 chains.

5. **Bismuth.**—This metal has been found in New South Wales, near Glen Innes, and also in the vicinity of Pambula, its discovery dating from 1877. About nine tons of metal and ore were exported during 1908. In Queensland the metal is found in the Hodgkisson and Herberton districts, at Ukalunda in the Ravenswood district, and at Biggenden in the Burnett district. The production in 1908 was valued at £2,915. It is stated that there are prospects of a substantial revival in mining affairs at Biggenden. In South Australia deposits are found at Balhannah, at Mount MacDonald, and at Winninnie, on the shores of Spencer's Gulf. In Tasmania $3\frac{3}{4}$ tons, valued at £462, were raised in 1908 at Middlesex.

6. **Chromium.**—In New South Wales chromium is found at Bowling Alley Point, on the Peel River, and also near Coolac, but the quantity raised at present is insignificant. Chrome iron ore is found in Queensland in the Rockhampton district, 184 tons being raised during the year 1908.

7. **Carnotite.**—A discovery of carnotite ore was made twenty miles from the Olary railway station in South Australia, and steps are being taken to test its value commercially.

8. **Cobalt.**—This metal was found at Carcoar in New South Wales in 1888, and subsequently at Bungonia, Port Macquarie, and various other places. 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.

9. **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 in addition to the lead contained in silver lead, ore, and concentrates, 14,936 tons of pig lead, valued at £186,746, were produced in 1908, as against 19,768 tons, valued at £374,182, in 1907. 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 contents of the ore. In 1908 the Lady Jane and Girofla mines at Mungana yielded 5154 tons of lead, valued at £69,444. The total quantity produced in Queensland in that year was 7109 tons, valued at £95,239.

10. **Mercury.**—In New South Wales mercury was first recorded by the Rev. W. B. Clarke in 1843. Cinnabar has been found in lodes and impregnations at various places, such as Bingara, Clarence River, etc. Up to the present the production of quicksilver has been small, the total being only a little over 1000 lbs. 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. Small quantities have been found near Willunga in South Australia.

11. **Manganese.**—Ores of this metal occur in considerable quantity 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. In Queensland there are extensive deposits at Gladstone, the product being utilised chiefly by the Mount Morgan mine. The production from the Mount Miller mine amounted in 1908 to 1368 tons of ore, valued at £5472. Large deposits of manganese have recently been discovered at Skyring's mine on Eel Creek, and at Mount Nansen mine on Mary Creek, about ten

miles to the south of Gympie. Extensive deposits of the ore were mined at Boolcunda in South Australia some years ago, but latterly the production has ceased. Deposits have also been noted at Kangaroo Island, Quorn, Tumby, and various other parts of the State. In Western Australia ores of the metal are found widely scattered, the black oxide being especially plentiful in the Kimberley district. In New Zealand deposits are found in various localities, but little has been done in the way of exploration.

12. Molybdenum.—In New South Wales molybdenite is obtained at Kingsgate, near Glen Innes, the export in 1908 being 9 tons, valued at £929, as compared with 22 tons, valued at £3564 in the previous year. The production in Queensland for 1908 was 89 tons, valued at £9224, the bulk of which was contributed by the Hodgkinson field.

13. Radium.—It is reported that there have been four 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 the second case a monazite from Pilbara, Western Australia, has been shewn to give off radium emanation when heated. Thirdly, a specimen of mineral having the composition of a secondary pitchblende has been discovered by a prospector. The exact place where this specimen was found is uncertain, but it is believed that it came from the New England district of New South Wales. It is stated that its radio-activity is very marked, the mineral being 1 per cent. more active than the Bohemian variety, and that it contained only such elements as were readily separated from one another by the methods used to obtain pure uranium and radium from Bohemian pitchblende. 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.

14. Tungsten.—Wolfram and scheelite, the principal ores of tungsten, are both mined to a small extent in New South Wales. During 1908 the export of wolfram was 86 tons, valued at £6,742, and of scheelite 154 tons, valued at £11,032. Wolfram was mined chiefly in the Deepwater division, and scheelite at Hillgrove. In Queensland it is obtained on the Hodgkinson, Etheridge, and Herberton fields, at Kangaroo Hills, Star River, and at Mount Windsor, in the Cook district, while a small amount of scheelite, valued at £20, was procured in the Herberton district during 1908. The production in 1908 was valued at about £38,124, contributed chiefly to by the mines on the Hodgkinson and Herberton fields. The Northern Territory of South Australia exported ore to the value of £542 in 1908 as against £11,450 in 1907, the output in 1908 being largely reserved for a rise in prices. Wolfram is mined in Tasmania at Ben Lomond and in the Middlesex district, the quantity exported in 1908 being 41 tons, valued at £4411. A rich lode of scheelite has been discovered on King Island in Bass Strait. In Western Australia a deposit of wolfram has recently been discovered in the West Kimberley district about 70 miles to the north-east of Derby.

15. 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. Small quantities of the mineral are also produced in the Northern Territory.

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. **Historical.**—Coal was discovered at a very early period in the history of Australia, the first mention of it dating from August, 1797, when its existence was noted in New South Wales by some survivors from the wreck of a vessel, who had walked from the southern portion of Australia up the coast to Sydney. The discovery was shortly afterwards confirmed by Surgeon Bass, who found coal in the cliffs southward of Point Solander, but the locality was at the time looked upon as so inaccessible that no attempt was made to utilise the deposits. During 1908, however, the South Coast district, in which the site of these discoveries occurs, produced over 1,929,236 tons of coal, valued at £570,022. In 1797 coal was also discovered at the mouth of the Hunter (or Coal) River by Lieutenant Shortland, and in this case, the deposits being more easily worked, it was not long before they were utilised, and a township sprang up which is now the port of one of the greatest coalfields in the world. The production for the northern district, of which Newcastle is the port, amounted in 1908 to 6,511,002 tons, valued at £2,625,446.

The discovery of coal in *Victoria* dates from the year 1825, when the mineral is reported to have been found at Cape Patterson. There is no record of production in the earlier years, but it is stated that the first Victorian coal placed on the Melbourne market came from Kileunda, in the vicinity of the original discovery. Up to 1889, with the exception of a little work by the companies at Moe and Narracan, the industry languished, the total production to the beginning of the year named being only about 25,000 tons. Early in 1889 the Government determined to come to the assistance of the industry, and the Coal Creek Company at Korumburra was registered, followed during next year by the Jumbunna Company, and the Outtrim, Howitt, and British Consolidated in 1894. The unfortunate strike of 1903 completely disorganised coal mining in Victoria, and the industry still suffers from its disastrous effects. In 1908 an extensive field of coal was discovered, through boring operations, in the Powlett River district. A seam of good, clean, hard coal, so far as proved, extends over an area of 3 miles by 2 miles, and averages 6 feet in thickness. In view of the probability of a State coal mine being established in the locality, the land some time ago was reserved from occupation for mining purposes, and surveys are being carried out with a view to the extension to district of the Nyora-Woolamai railway, which is now in course of construction. In July, 1909, the Coal Mines Regulation Bill, providing *inter alia* for the establishment of a State coal mine, was introduced in the Legislative Assembly of Victoria. Other payable seams in this district outcrop about five miles away, near Cape Patterson, and it is believed that the coal-bearing area extends over twelve to fifteen square miles.

The existence of coal in *Queensland* was known soon after the establishment of the first settlement at Moreton Bay, mines near Ipswich, on the banks of the Bremer Creek and Brisbane River, having been worked almost continuously since that date. Seams in the Wide Bay district have been operated on since 1870, while good coal was mined at Clermont shortly after the establishment of the copper mines in that locality. A seam of good coal has also been discovered at Mount Mulligan, 32 miles from Dimbulah Station, on the Chillagoe railway. A seam of coal has recently been discovered in the vicinity of the Cooktown district, and plans for boring have been projected. 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.

In *South Australia* brown coal of fair quality was found in 1889 at Kuntha Hill, 110 miles north of Hergott, and at Leigh Creek, on the Great Northern railway line. The discovery of coal in *Western Australia* dates from 1846, when the mineral was found on

the Murray River. Since that year coal has been met with in other localities, but production at the present time is confined to the deposits at the Collic River. In *Tasmania* coal was discovered between the Don and Mersey Rivers in 1850. The value of the deposits at Fingal was first proved in 1863, two tons of this coal producing nearly 14,000 cubic feet of gas.

2. **Production of Coal.**—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 1908.

Year.	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.	Cwth.
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
1902	5,942,011	225,164	501,531	...	140,884	48,863	6,858,453
1903	6,354,846	69,861	507,801	...	133,427	49,069	7,115,004
1904	6,019,809	121,742	512,015	...	138,550	61,109	6,853,225
1905	6,632,138	155,136	529,326	...	127,364	51,993	7,496,957
1906	7,626,362	160,631	606,772	...	149,755	52,896	8,506,416
1907	8,657,924	138,435	683,272	...	142,373	58,891	9,681,095
1908	9,147,025	113,962	696,332	...	175,248	61,068	10,193,635
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	2,672,770
1902	2,206,538	155,850	172,286	...	86,188	19,546	2,640,468
1903	2,319,660	43,645	164,798	...	69,128	19,628	2,616,859
1904	1,994,952	70,208	166,536	...	67,174	24,444	2,323,314
1905	2,003,461	79,060	155,477	...	55,312	20,797	2,314,107
1906	2,337,227	80,283	173,282	...	57,998	21,158	2,669,948
1907	2,922,419	79,706	222,135	...	55,158	23,556	3,302,974
1908	3,353,093	64,778	244,922	...	75,694	24,427	3,762,914

In New South Wales there was an increase in the output for 1908, as compared with the previous year, in both the Northern and Southern districts, while there was a decrease in the Western district. (See page 517 hereinafter).

In Queensland nearly the whole of the increase in 1908 is accounted for by the larger output in the Wide Bay and Central districts. In the Southern district, the mines at Ipswich and Bundamba, which are responsible for the greater proportion of the State's output, shew a record but little higher than in 1907.

3. **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	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	Very inferior.

No serious attempt has been made to use the deposits of brown coal or lignite as a source of fuel. The Triassic 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. Probably these beds extend under the great western plains, but the presence of artesian water precludes the possibility of their being 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 25,000 square miles. 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. 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 quantity of coal wrought in New South Wales during the year 1908 constitutes a record output, although the output from the Western district shews a decrease of 57,132 tons as compared with the previous year. The greatest increase is in the Northern district, and amounts to 452,422 tons as compared with 1907. The quantity and value of the coal raised in each district during the years 1887, 1901, 1907, and 1908 will be seen in the following table :—

COAL RAISED IN NEW SOUTH WALES, 1887 to 1908.

District.	1887.		1901.		1907.		1908.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	£	Tons.	£	Tons.	£	Tons.	£
Northern ...	2,243,792	1,006,720	3,999,252	1,669,519	6,058,580	2,231,901	6,511,002	2,625,446
Southern ...	376,563	170,684	1,544,454	407,186	1,835,425	515,786	1,829,236	570,022
Western ...	302,137	79,036	424,720	102,214	763,919	174,732	706,787	157,625
Total ...	2,922,497	1,346,440	5,968,426	2,178,929	8,657,924	2,922,419	9,147,025	3,353,093

So far back as 1847 the Rev. W. B. Clarke expressed the belief that workable coal would be found in the strata below Sydney, a belief that was also held by subsequent geologists, who based their contentions on stratigraphical and palæontological evidence. The later geologists urged that the Illawarra coal measures of the South Coast district were identical with the Newcastle measures of the Northern district, although it was agreed that the deposits in the neighbourhood of Sydney would probably be found at a considerable depth. Borings were made in several localities close to Sydney, and in 1891 a drill put down at Cremorne Point in Sydney Harbour passed through a seam of coal seven feet four inches thick and at a depth of 2801 feet. Unfortunately the site of the bore happened to be in the vicinity of a volcanic dyke, which had cindered the coal near the locality of its intrusion. A second bore was commenced in July, 1892, and in November, 1893, a seam of excellent coal, ten feet three inches thick, was reached at 2917 feet. The results attained led to the formation of a company which acquired land at Balmain, and expended a considerable sum of money in the purchase of plant suitable for working coal at such a great depth. Sinking operations were commenced in June, 1897, and coal was struck at a depth of 2880 feet on the 21st November, 1901. Up to the present developmental work has not sufficiently advanced to permit of any considerable production.

(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. The coal is of excellent quality for steaming and household purposes. The full exploitation of the Victorian coal deposits has,

however, been rather severely hindered by various obstacles. In the Report of the Royal Commission on the Coal Industry, 1906, these have been summarised as follows:—(1) Labour troubles. (2) Difficulties of working arising from faults, displacements, and thin seams. (3) Increased cost of production as the workings extend. (4) The low price ruling for coal.

Deposits of brown coal and lignite of immense extent occur in gravels, sands, and clays of the Cainozoic period throughout Gippsland, Mornington Peninsula, Werribee Plains, Gellibrand, and Barwon and Moorabool basins. In the Latrobe Valley the beds reach a thickness of over 800 feet. When dried, the material makes good fuel, but owing to its excessive combustibility and friability requires to be consumed in specially constructed grates. Attempts have been made to manufacture briquettes from the brown coal, but so far without any great measure of success. It is stated that a company has recently been formed to install a modern plant at Morwell for the manufacture of briquettes and the recovery of the by-products. Reference has already been made to the proposal to establish a State coal mine in the Powlett River district. (See page 515 *ante*.)

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

PRODUCTION OF COAL IN VICTORIA, 1902 to 1908.

Year.	Outtrim Howitt Company.	Jumbunna Coal Company.	Coal Creek Proprietary.	Silkstone Co-operative Company.	Other Companies.	Total Production.	Value.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	£
1902	114,686	67,876	39,257	2,257	1,088	225,164	155,850
1903	20,602	18,517	20,727	4,354	5,661	69,861	43,645
1904	57,328	39,364	22,547	2,014	489	121,742	70,208
1905	71,989	49,009	27,710	1,624	4,804	155,136	79,060
1906	74,812	64,222	13,214	3,977	4,406	160,631	80,283
1907	64,083	61,755	3,762	7,565	1,470	138,635	79,706
1908	47,633	58,552	...	6,967	810	113,962	64,778

The figures for 1908 include 500 tons of brown coal, valued at £125.

The coal from Leigh's Creek in South Australia is subject to similar disabilities as the Victorian brown coal, and until some means are devised of overcoming these, production will probably languish.

(iii.) *Queensland.* In Queensland the coal-bearing strata are of vast extent and wide distribution, being noted under the greater portion of the South-eastern districts, within 200 miles of the sea, as far north as Cooktown, and under portions of the far western interior. The Ipswich beds are estimated to occupy about 12,000 square miles of country, while the Burrum fields occupy a considerably larger area. At Callide, fifty miles west of Gladstone, a seam of coal free from bands has been struck in a shaft only 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. 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 1908.

Year	...	1861.	1871.	1881.	1891.	1901.	1906.	1908.
Quantity	Tons	14,212	17,000	65,612	271,603	539,472	606,772	696,332
Value	£	9,922	9,407	29,033	128,198	189,877	173,282	244,922

At present coal mining in Queensland is in a very satisfactory position, the increasing volume of the trade being chiefly due to the action of the Government in granting concessions to vessels coaling at local ports.

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

QUEENSLAND COLLIERIES, 1907 AND 1908.

Collieries.	1907.		1908.	
	Tons Raised.	Average Value at Pit's Mouth	Tons Raised.	Average Value at Pit's Mouth.
		s. d.		s. d.
Ipswich and Darling Downs ...	591,174	6 1½	591,535	6 6½
Wide Bay ...	77,921	8 4	84,817	9 5½
Rockhampton and Central District ...	14,077	11 6¾	18,480	11 7½
Other (Nundah) ...	100	...	1,500	...
Total ...	683,272	6 6	696,332	7 0½

A considerable proportion of the produce of the Ipswich district is supplied to vessels for bunker coal. The average value of coal in all districts was higher in 1908 than in 1907, a condition due to the raising of prices and the higher scale of wages which came into operation in the majority of the collieries at the beginning of the year 1908.

(iv.) *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 Mesozoic beds of the south-west. The coal produced is bright and clean, but very fragile when free from moisture. The improved output in 1908 is consequent on the establishment of a bunkering trade at Bunbury and Fremantle, which has developed very satisfactorily. The production from this field during the last eight years was as follows:—

PRODUCTION OF COAL IN WESTERN AUSTRALIA, 1901 to 1908.

Year	...	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
Quantity	Tons	117,836	140,884	133,427	138,550	127,364	149,755	142,373	175,248
Value	£	68,561	86,188	69,128	67,174	55,312	57,998	55,158	75,694

(v.) *Tasmania.* In Tasmania coal occurs in the Carboniferous and Mesozoic systems, the product of the former class being, however, far inferior to that of the latter. Carboniferous seams occur at the Don, Tarleton, Latrobe, Port Cygnet, Tippiagory Range, St. Mary's, and Adventure Bay, the seam at Port Cygnet having a thickness of two feet and being of fair quality. The Mesozoic coal measures are well developed in the Fingal basin, the Cornwall coal from this locality being excellent for household purposes. The chief production of recent years has been furnished by the Mt. Nicholas and

Cornwall mines, but it is hoped that ere long the production from the Sandfly mine will assume considerable proportions. The quantity of coal raised during the years 1901 to 1908 in the various districts was as follows:—

PRODUCTION OF COAL IN TASMANIA, 1901 to 1908.

District.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
North-western ...	2,952	1,683	1,735	2,282	1,261	1,878	1,045	...
Eastern ...	37,239	41,735	43,157	54,567	46,708	46,803	53,214	55,539
Midland ...	1,536	725	1,047	940	200	393	624	...
South-eastern ...	...	60	30	200	200	1,483	} 4,008	5,529
South-western ...	3,711	4,660	3,100	3,120	3,624	2,339		
Total ...	45,438	48,863	49,069	61,109	51,993	52,896	58,891	61,068

4. **Production of Coal in Various Countries.**—The total known coal production of the world in 1908 amounted to about 1100 million tons (exclusive of brown coal or lignite), towards which the Commonwealth contributed 10 million tons, or rather less than 1 per cent. The following table shews the production of the British Empire and the chief foreign countries in units of 1000 tons during each year of the period 1901 to 1908:—

BRITISH EMPIRE.

Year.	United Kingdom.	British India.	Canada.	Australian C'wealth.	New Zealand.	South Africa.
	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.
1901 ...	219,047	6,636	5,791	6,884	1,228	1,465
1902 ...	227,095	7,424	6,667	6,860	1,363	2,179
1903 ...	230,334	7,438	7,107	7,112	1,420	2,911
1904 ...	232,428	8,216	7,370	6,854	1,538	3,260
1905 ...	236,129	8,418	7,789	7,496	1,586	3,709
1906 ...	251,058	9,783	8,717	8,596	1,730	4,185
1907 ...	267,831	11,147	9,885	9,681	1,831	4,679
1908 ...	257,373	12,661	10,730	10,194	1,874	4,549

FOREIGN COUNTRIES.

Year.	Russian Empire.	Sweden.	German Empire.	Belgium.	France.	Spain.	Austria-Hungary.	Japan.	United States.
	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.
1901 ...	16,215	268	106,795	21,855	31,125	2,609	12,895	8,885	261,875
1902 ...	16,156	300	105,747	23,493	28,893	2,679	12,012	9,589	269,277
1903 ...	17,532	315	114,763	23,415	33,668	2,654	12,526	9,979	319,068
1904 ...	19,042	316	118,874	22,395	32,964	2,974	12,813	10,602	314,122
1905 ...	18,389	317	119,350	21,506	34,652	3,152	13,454	11,593	350,821
1906 ...	21,302	292	134,914	23,232	33,762	3,157	14,437	12,791	369,672
1907 ...	21,000	305	140,885	23,324	35,586	3,637	14,927	13,716	428,896
1908 ...	22,581	295	*	23,304	37,027	*	*	13,721	373,366

* Not available.

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

5. **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 1908 was 2,560,842 tons, valued at £1,348,926, of which amount 2,558,366 tons, valued at £1,347,237, were exported from New South Wales.

(i.) *New South Wales.* In the following table will be found the quantity and value of the exports at decennial intervals since 1881 and during the last five years. The figures for New South Wales 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 1908.

Year.	1881.	1891.	1901.	1904.	1905.	1906.	1907.	1908.
Quantity ... 1000 tons	1,030	2,514	3,471	3,173	3,718	4,962	5,744	6,099
Value ... £1000	417	1,307	1,682	1,381	1,484	2,081	2,662	3,021

The principal countries to which coal was exported from New South Wales during the year 1908 were as shown hereunder. The quantity and value refer strictly to exports, and exclude bunker coal :—

DESTINATION OF NEW SOUTH WALES COAL, 1908.

Country.	Quantity.	Value.	Country.	Quantity.	Value.
	Tons.	£		Tons.	£
Victoria ...	1,017,214	577,229	New Zealand ...	285,043	145,760
South Australia ...	635,326	348,905	Peru ...	78,223	42,121
Chile ...	789,620	427,820	Hawaii...	65,918	35,828
Philippine Islands...	351,441	190,899	United States ...	188,498	102,073
Straits Settlements	217,809	111,680	India ...	164,352	83,247
Western Australia...	123,834	62,154	Tasmania ...	102,599	43,297

The quantity of bunker coal taken from New South Wales by oversea vessels was about 1,273,092 tons, valued at £684,862.

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

**DISTRIBUTION OF TOTAL OUTPUT OF NEW SOUTH WALES COAL,
1904 to 1908.**

Year.	Exports to Australasian Ports.	Exports to other Ports.	Local Consumption.	Total.
	Tons.	Tons.	Tons.	Tons.
1904 ...	1,880,545	1,292,322	2,846,942	6,019,809
1905 ...	2,066,576	1,651,477	2,914,085	6,632,138
1906 ...	2,260,090	2,701,450	2,664,822	7,626,362
1907 ...	2,379,024	3,364,483	2,914,417	8,657,924
1908 ...	2,715,310	3,383,366	3,048,349	9,147,025

(ii.) *Queensland.* In 1908 Queensland's oversea export of coal was almost negligible, being 1688 tons, as compared with 9019 tons in 1907.

6. 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 shows the consumption of coal in Australia, computed in the manner specified, for the last four years :—

CONSUMPTION OF COAL IN AUSTRALIA, 1905 to 1908.

Year.	Quality of Coal Consumed.			
	Home Produce.	Produce of the United Kingdom.	Produce of Other Countries and Colonies.	Total.
	Tons.	Tons.	Tons.	Tons.
1905	5,468,000	...	8,000	5,476,000
1906	5,352,000	1,000	15,000	5,368,000
1907	5,954,000	3,000	12,000	5,969,000
1908	6,358,000	4,000	11,000	6,373,000

7. **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 further decline then set in until 1905, when the price stood at a little over 6s., followed by a rise of one penny in 1906. In 1907 the average was 6s. 9d. and in 1908 was 7s. 4d. 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 IN NEW SOUTH WALES (PER TON), 1904 to 1908.

Year.				Northern District.	Southern District.	Western District.
				s. d.	s. d.	s. d.
1904 ... ..	...	...	...	7 2.10	5 7.25	5 1.91
1905 ... ..	...	...	...	6 4.15	5 5.03	5 0.15
1906 ... ..	...	...	...	6 5.28	5 6.60	4 10.81
1907 ... ..	...	...	...	7 4.41	5 7.44	4 6.90
1908 ... ..	...	...	...	8 0.78	5 10.91	4 5.52

(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 1906, 10s., for 1907, 11s. 6d., and for 1908, 11s. 5d.

(iii.) *Queensland.* The average price of coal at the pit's mouth in Queensland during the period 1900 to 1908 ranged from 5s. 8½d. in 1906 to 7s. in 1901. Prices in the principal coal-producing districts during the last four years were as follows:—

PRICES OF COAL, QUEENSLAND, 1905 to 1908.

District.	Value at Pit's Mouth.			
	1905.	1906.	1907.	1908.
	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
Ipswich and Darling Downs	5 4	5 2½	6 1½	6 6½
Wide Bay and Maryborough	7 8½	8 0½	8 4	9 5½
Rockhampton and Central	12 0	11 2½	11 6½	11 7½

(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. 8d., 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., and in 1908 it was 8s. 7½d. 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, 9s. 8d., in 1905, 9s. 8d., in 1906, 9s. 9d., and in 1907 and 1908 it was 8s. per ton.

8. **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, for the four years ended 1907, was as follows:—

PRICES OF FOREIGN COAL, 1904 to 1907.

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.
1904 ...	7 2½	8 6½	10 10½	10 8	5 10½
1905 ...	6 11½	8 7½	10 6½	10 2½	5 8
1906 ...	7 3½	8 11	11 2½	12 2½	5 9½
1907 ...	9 0	9 8½	...	13 8½	5 11½

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, 1904 to 1907.

Year.	British India.	C'wealth of Australia.	New Zealand.	Canada.	Transvaal.	Cape of Good Hope.	Natal.
	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
1904	3 5	6 10	10 9	9 3	8 3	20 0	10 8
1905	3 4	6 2	10 7	9 4	7 3	18 8	8 3
1906	3 11	6 3	10 7	9 4	6 5	18 5	8 6
1907	4 8	6 10	10 7	10 9	6 0	18 5	9 0

9. **Employment and Accidents in Coal Mining.**—The number of persons employed in coal mining in each of the States during the year 1908 is shewn below. The table also shews 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, give the total known number of persons engaged in mining and quarrying throughout the world as about 5¼ millions, more than one-half of whom were employed in coal mining, the number in the United Kingdom being 918,400; the United States, 641,000; Germany, 545,000; France, 175,000; Belgium, 143,000; Austria, 70,000; and India, 113,000.

The latest returns shew the death rate in the United Kingdom in respect of deaths through accidents in coal mines as 1.31, and for the British Empire 1.33 per 1000 persons employed in coal mines. For France the rate is given as 1.10, for Germany 2.55, and the United States 4.66. For foreign countries generally the rate is stated at 3.04 per 1000.

EMPLOYMENT AND ACCIDENTS IN COAL MINING, 1908.

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 ...	17,734	21	111	1.17	6.26	435,572	82,405
Victoria ...	542	1	7	1.85	12.91	113,962	16,280
Queensland ...	1,672	3	29	1.79	17.34	232,111	24,011
South Australia ...	...	...	...	...	...	...	...
Western Australia ...	280	1	32	...	114.28	...	5,477
Tasmania ...	189	*	*	*	*	*	*
Commonwealth†	20,228	26	179	1.28	8.85	389,714	56,606

* Not available.

† Exclusive of Tasmania.

§ 11. Coke.

1. **Production of Coke.**—Notwithstanding the large deposits of excellent coal in Australia there is at the present time a fairly considerable amount of coke imported from abroad, the oversea import during the year ended 1908 amounting to 10,204 tons, valued at £13,610, the bulk of which came from the United Kingdom and Germany, and was taken chiefly by South Australia and Western Australia. Various reasons were at one time adduced to account for the rejection of the local article, such as excessive friability in transport, lack of strength to sustain the weight of large ore bodies in reduction works, excessive amount of ash, etc. These disabilities have, however, largely been overcome, so that succeeding years should see continued expansion in local production. Extensive shipments of coke were obtained from Germany in 1908 for the Wallaroo and Moonta smelters, and for the Broken Hill Proprietary's works at Port Pirie. In explanation of this, it has been stated that while supplies in Australia were not sufficient to meet demands and ensure continuity in supply, there has been considerable over-production at German coke works. In New South Wales the industry is making rapid progress, as the figures hereunder will shew:—

COKE MADE IN NEW SOUTH WALES, 1904 to 1908.

Year.	1904.	1905.	1906.	1907.	1908.
Quantity ... Tons	171,006	162,961	186,060	254,609	283,873
Value, total ... £	110,692	100,306	110,607	159,316	199,933
Value per ton ...	12s. 11d.	12s. 4d.	11s. 11d.	12s. 6d.	14s. 1d.

It may be seen that notwithstanding the depression in metalliferous mining in 1908 the production for the year shews an increase of 29,264 tons and £40,617 in value.

A small quantity of coke is made in Queensland, but the bulk of that used in ore reduction is imported, mainly from New South Wales. The following table shews the amount manufactured locally in this State, and the amount imported during the last four years; the quantities imported include shipments landed from other States of the Commonwealth:—

QUEENSLAND—COKE MANUFACTURED LOCALLY AND IMPORTED, 1905 to 1908.

Year.	1905.	1906.	1907.	1908.
Manufactured locally ... tons	8,650	8,672	8,280	10,684
Imported ... „	9,823	22,661	34,013	58,079

The development in smelting operations in Queensland is reflected in the increased consumption of coke. It is reported that increased provision is being made for the manufacture of coke in the Ipswich district.

It must be understood that the coke referred to above is the production of coke-making establishments only, and does not include the inferior article produced at gasworks.

§ 12. Oil Shale and Mineral Oils.

1. **Production of Shale.**—(i.) *New South Wales.* As pointed out by Mr. E. F. Pittman, the name kerosene shale has been rather inaptly applied to a variety of torbanite, cannell, or boghead mineral found at various geological horizons in New South Wales. The mineral does not, as a rule, split in parallel layers, the fracture being rather of a conchoidal type. Pure samples have been found to contain over 89 per cent. of volatile hydro-carbons and over 5 per cent. of fixed carbons. The discovery of the mineral in New South Wales dates probably from 1827, although the first authentic mention by a scientific observer dates from 1845, when its occurrence in the Hartley Vale district was noted by Count Strzelecki. 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 1908 amounted to 46,303 tons, valued at £26,067, the whole of it being raised in the mines controlled by the Commonwealth Oil Corporation Limited at Hartley Vale, New Hartley, and Wolgan. Up to the end of 1908 the entire production for the State amounted to 1,373,301 tons, valued at £2,193,568.

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

(iii.) *Queensland.* Deposits of oil shale are known to exist at various localities in Queensland, and what is believed to be a payable oil bearing area has been located near Roma. In 1907 a contract was let for sinking a bore at this place to search for artesian water, natural gas, or petroleum, to a depth of 4500 feet. In October, 1908, when the bore had reached a depth of 3702 feet, a flow of gas, estimated at over 1,000,000 cubic feet per day, was struck and became ignited accidentally. The fire was extinguished, and after an extra length of casing had been put down the gas was apparently shut off from below. Boring will be continued till the stipulated depth of 4500 feet is reached.

(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. Allusion to the mineral known as Goorongite is made in sub-section 13.

(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.

(vi.) *Tasmania.* The deposits of oil shale (Tasmanite) in the Mersey district are not at present being worked. The known shale area extends over a strip of country about six miles long and two miles wide, but it is probable that the area in which the shale beds occur is more extensive than is at present known. It is intended to have a departmental examination of the district made shortly. Kerosene shale of fine quality is found in the country between the Jessie and Flowerdale Rivers, but the extent of the beds has not been proved. The seams are in a series of sandstones and clays, approximately 250 feet thick; one of these seams is 20 inches in thickness.

2. **Export of Shale.**—In 1908 New South Wales exported 18,870 tons of shale valued at £35,766, of which 8907 tons were sent to the Netherlands; 6197 tons to the United Kingdom; and 2878 tons to Ceylon.

§ 13. Other Non-Metallic Minerals.

1. **Alunite.**—Probably the most remarkable deposit of alunite in the world occurs at Bulladelah, in the county of Gloucester, New South Wales, a large proportion of a low range of mountains in the district being composed of this mineral. The deposits are worked by quarrying, and up to the end of 1908, 29,968 tons had been raised, valued at £90,417, the production for the year 1908 being 1082 tons, valued at £2705. It is reported that large deposits of a high-class alunite have been discovered near Sunbury, Victoria.

2. **Asbestos.**—This substance has been found in various parts of Australia, but up to the present has not been produced in sufficient quantity to warrant special notice. In Western Australia what may prove to be a valuable deposit of the fibrous chrysotile variety has been located at Tambourah, on the West Pilbara goldfield, and in 1908 forty tons, valued at £1600, were exported therefrom. In 1899 Tasmania raised 200 tons, valued at £363, but there has been no production during the last seven years. Deposits of asbestos of the mountain leather and mountain cork varieties have recently been discovered at Oodlawirra in South Australia.

3. **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. It is stated that kaolin of a very fine class has been discovered near Murwillumbah, and that there is every prospect of large works for the manufacture of pottery being established in the district. In Victoria 547 tons of kaolin of the finest quality, valued at £591, were raised during 1908, mostly at Egerton. There are also large deposits of kaolin near Heathcote, Victoria. In Queensland 2680 tons of fireclay, valued at £1072, were mined during the year 1908. 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, and it is stated that a syndicate has recently been formed to work these deposits. Two deposits of yellow ochre have been opened up in New South Wales, one near Dubbo and the other at Webb's Creek on the Hawkesbury River. Good samples of umber have also been obtained in New South Wales, and water paints from materials raised in that State have achieved considerable success. A silicate paint has been placed on the market, and successful experiments of a preliminary nature have been carried out with the view of proving how far local materials can be used for the preparation of colours requiring chemical treatment, and siennas, greens, and other colours have been exhibited. Extensive deposits of iron oxide, giving a return of 80 per cent. ochre, have recently been discovered near Oodlawirra in South Australia.

4. **Coorongite.**—This peculiar indiarubber-like material was first noted many years ago near Salt Creek and in the vicinity of Coorong Inlet, in South Australia. 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.

5. **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. In Victoria the mineral occurs in Ordovician slates in several of the goldfields, but is not worked. In Queensland the mineral is raised by the Graphite Plumbago Company at Mt. Bopple, near Netherby, on the Maryborough-Gympie line. During the year 1908 this company was engaged in deepening the shaft of their mine, and in the course of these operations raised 20 tons of ore, valued, undressed at the mine, at £3 a ton. In 1907 the quantity produced was 65 tons, valued at £200. There is an extensive deposit of the mineral at Mt. Bopple, but the quality is rather inferior. In Western Australia a company has recently been formed to work deposits near Bunbury.

6. **Gypsum.**—This mineral is found at various places in the Commonwealth. In South Australia deposits are being worked at Lake Fowler and near Marion Bay, Yorke Peninsula.

7. **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 yet been worked commercially. The opening up of the Barraba railway has, however, led to the taking up for mining purposes of a deposit of diatomaceous earth which has been recently localised. If, as seems likely, the material can be placed on the Sydney market at a reasonable price, a moderate output may be obtained. In Victoria there is a remarkably pure deposit at Lillieur, near Talbot, while beds of the mineral are also met with at Clunes and Portland. From the deposit at Talbot, 150 tons, valued at £600, were obtained in 1908.

8. **Salt.**—Salt is obtained from salt lakes in the western and north-western districts of Victoria, and from salterns in the neighbourhood of Geelong. 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. Large quantities are also obtained from the shallow salt lakes of South Australia, chiefly on Yorke Peninsula. Lake Hart, about sixty 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. The production of crude salt in South Australia during 1908 was 75,000 tons, valued at £37,500.

9. **Natural Manures.**—In Victoria large quantities of "copi," an impure hydrous sulphate of lime, are obtained in the North-western district. South Australia possesses deposits of rock phosphate near Port Clinton and Ardrossan on Yorke Peninsula, at Belvedere near Kapunda, and at Koorunga, and also at many other places which have only been prospected to a small extent. The production in 1908 was valued at £11,000. Although it can hardly be considered a mineral product, mention may be made here of the large accumulations of guano on the Aboelhos 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 being available shewing the production of 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 Cudjegang field was discovered in 1867, and shortly afterwards the Bingara diamantiferous deposits were located. None of the diamonds so far discovered have proved of any considerable size, the largest weighing about $6\frac{1}{2}$ carats. Stones of small size are also found at Cope's Creek and other places in the Inverell district. The chief production in 1908 was from Copeton in the Tingha Division. It is difficult to obtain accurate returns in connection with the production of precious stones, but the yield of diamonds in 1908 was estimated at 2205 carats, valued at £1358, while the total production to the end of 1908 is given as 161,880 carats, valued at £107,503. 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. A few small

diamonds have been found in the Pilbara district in Western Australia. In South Australia diamonds have been found on the Echuanga 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. The gems 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 last year was valued at £15,200, and up to the end of 1908 the total was £117,477.

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 is now the centre of production. The value of opal raised last year was estimated at £41,800, of which £31,800 worth was raised in the White Cliffs district, and the balance at the Wallangulla field in the Walgett division. Beautiful specimens of "black" opal, realising over £40 an ounce, have been obtained at the last-mentioned field. Since the year 1890 the total value of opal won is estimated at £1,109,899.

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 1908 was estimated at £2500, and up to the end of that year at £161,500. 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.

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 twenty-three 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 reopened and worked for a short period during 1908. Particulars as to the quantity and value of emeralds won are not available, and the mine has again been closed down. 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 *zircons* and *garnets*. Turquoises are also found in thin veins in Victoria, but the deposit is not rich enough to pay for expenses of working. Fine *agates* are found in many places in Victoria, but have not been made use of to any extent. 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. In South Australia *tourmaline* has been found on Kangaroo Island and *beryls* near Williamstown.

(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 is an index of the significance of the mineral wealth. During the year 1908 the number so employed was as follows:—

NUMBER OF PERSONS ENGAGED IN MINING, 1908.

State.	Number of Persons Engaged in Mining for						Total.
	Gold.	Silver, Lead, and Zinc.	Copper.	Tin.	Coal and Shale.	Other.	
New South Wales ...	6,863	7,560	2,745	2,456	18,084	1,757	38,965
Victoria ...	20,853	3	9	53	542	126	21,586
Queensland ...	8,515	496	3,540	2,140	1,672	955	17,318
South Australia ...	1,213	51	4,558	384	...	968	7,174
Western Australia ...	16,075	5	283	614	280	9	17,266
Tasmania* ...	...	...	...	...	...	...	6,148
Commonwealth ...	53,019†	8,115†	11,135†	5,647†	20,578†	3,815†	108,457

* Not available.

† Exclusive of Tasmania.

The following table shews the number of persons engaged in mining in the Commonwealth during each of the years 1891, 1901, and 1908, together with the proportion of the total population so engaged:—

PROPORTION OF PERSONS ENGAGED IN MINING, AUSTRALIA, 1891, 1901, 1908.

State	1891.		1901.		1908.	
	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	38,965	2,465
Victoria ...	24,649	2,151	28,670	2,381	21,586	1,715
Queensland ...	11,627	2,934	13,352	2,664	17,318	3,152
South Australia ...	2,683	834	7,007	1,931	7,174	1,843
Western Australia ...	1,269	2,496	20,895	11,087	17,266	6,514
Tasmania ...	3,988	2,695	6,923	4,017	6,148	3,388
Commonwealth ...	74,820	2,341	113,462	2,992	108,457	2,561

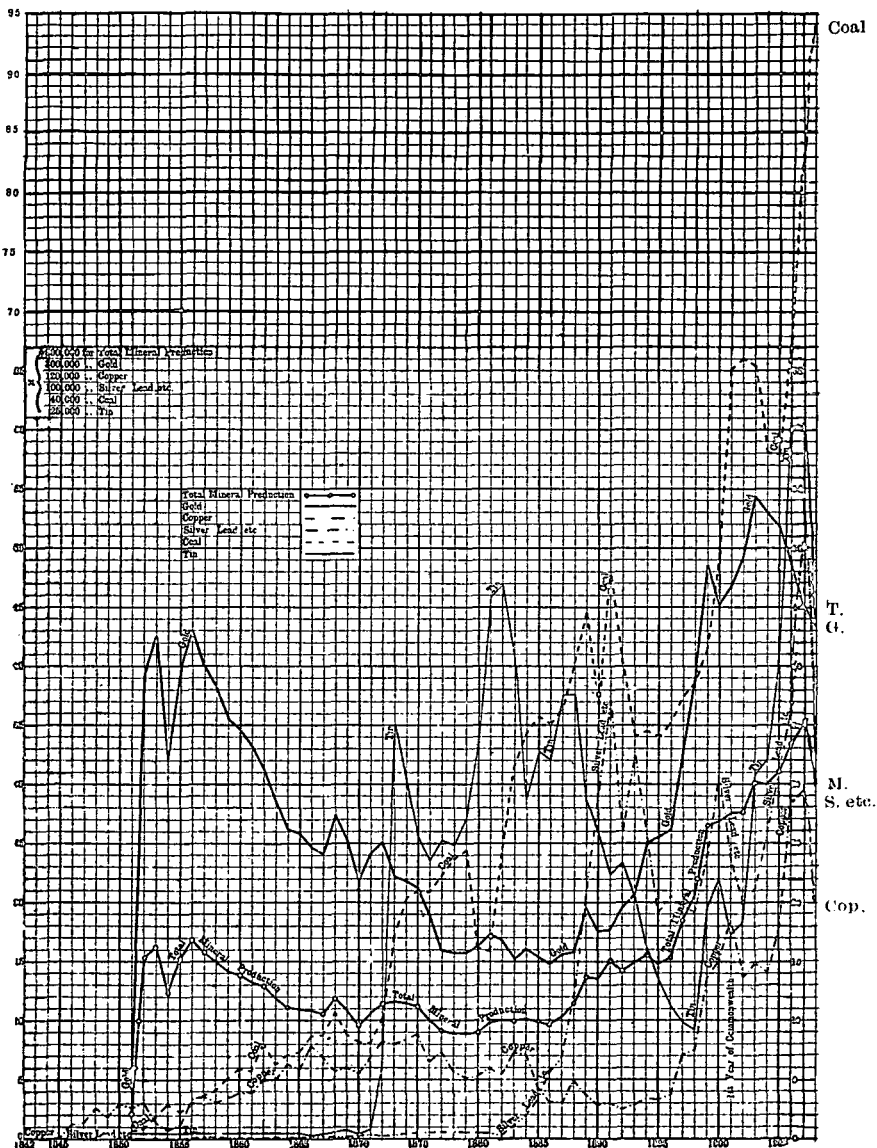
2. **Wages Paid in Mining.**—In the next table will be found a statement of the average wages earned by employes in the chief branches of the mining industry in Australia. The value of the figures is rather prejudiced by the wide diversity of conditions, not only in the several States but in different districts of the same State.

The figures quoted for New South Wales in gold mining refer to the Hillgrove and Mount Boppy districts: For copper the figures refer to the Cobar district, and represent rates as awarded by the Arbitration Court. The maximum is paid when copper is £115 per ton or over, and the minimum when the metal is £70 per ton and under, a graduated rate prevailing between the extremes. The rates for silver miners are those ruling at Broken Hill. As regards Queensland the rates for hewing in coal mines are for miners not doing their own wheeling. Where own wheeling is done the rate varies from 2s. 3d. to 5s. 6d. No distinction was made as to class of mining in the returns received from South Australia, and the figures have, therefore, been placed with copper mining. Generally speaking, the classification of the labour in the various States does not permit of very satisfactory comparisons.

WAGES PAID IN MINING INDUSTRY IN THE COMMONWEALTH, 1908-9.

Class of Mine.	New South Wales.	Victoria.	Queensland.	South Australia.	Western Australia.	Tasmania.
	per day.	per day.	per day.	per day.	per day.	per day.
GOLD—						
Labourers ...	6/6 to 8/4	6/6	6/- to 12/-	6/8	10/- to 11/10	7/-
Bracemen ...	7/- to 8/4	7/-	3/5 to 12/-	8/-	11/8 to 13/4	7/6
Platmen ...	7/- to 8/4	6/6	7/- to 13/4	7/-	11/8 to 13/4	7/6
Miners ...	7/- to 10/6	7/6	8/2 to 13/4	8/9		7/6
Wet ...	8/4 to 10/-	8/4	...	11/-	11/8 to 13/6	8/4
Shaft-sinking ...	8/4 to 10/6	8/4	...	10/-		8/4
Wet ...	...	...	...	11/-		9/2
Blacksmiths ...	8/- to 11/-	8/-	6/- to 16/8	8/9	13/ to 14/	8/-
Carpenters ...	9/- to 11/-	8/-	8/- to 16/8	9/3	15/-	8/-
Engine-drivers—						
Stationary ...	7/6 to 10/-	...	8/- to 16/8	8/3	13/ to 15/9	8/-
Winding ...	8/6 to 11/-	8/4		9/-		8/4
Battery feeders ...	5/- to 8/-	5/-	6/8 to 13/4	6/8	10/- to 11/10	8/-
Shift bosses ...	10/- to 13/4	8/4	9/- to 14/-	12/-	16/3	wk. salary
Machine miners ...	8/- to 10/-	7/6	9/- to 14/-	10/-	13/4 to 15/6	8/4
Timbermen ...	8/4 to 11/-	8/-	7/6 to 15/-	9/3	13/4 to 15/-	8/4
SILVER-LEAD—						
Labourers ...	6/6 to 8/7½			6/8		7/6 to 8/6
Bracemen ...	7/6 to 9/6			8/-		7/- to 9/-
Miners ...	7/6 to 10/-		(Note.—The above figures refer to averages per shift in all metalliferous mines in Q'nsland)	8/9		8/4 to 10/-
Blacksmiths ...	8/- to 12/-			8/9		9/- to 12/2
Carpenters ...	9/- to 11/6			9/3		9/- to 13/4
Engine-drivers—		Not mined.			Same as gold.	
Winding ...	9/- to 11/-			9/-		9/4 to 17/-
Shift bosses ...	10/- to 14/-			12/-		10/- to 12/-
Truckers ...	6/6 to 8/7½			7/6		7/6 to 9/-
Timbermen ...	9/- to 11/6			9/3		8/4 to 10/-
COPPER—						
Labourers ...	6/6 to 8/-	6/6 to 7/-	...	6/8		8/6 to 10/6
Miners ...	7/6 to 10/-	7/- to 8/4	...	8/9		9/6 to 10/6
Blacksmiths ...	8/- to 10/6	8/4 to 9/-	...	8/9		10/6 to 13/-
Carpenters ...	9/- to 11/-	8/4	...	9/3		10/6 to 12/-
Engine-drivers—					Do.	
Winding ...	8/4 to 11/-	8/4	(see above)	9/-		11/-
Bracemen ...	6/6 to 8/4	6/6		8/-		9/- to 9/6
Drill sharpeners ...	8/- to 12/-	7/6		9/-		9/- to 9/6
Timbermen ...	8/4 to 10/-	7/6 to 8/4	...	9/3		10/- to 11/6
Machine miners ...	8/6 to 10/-	8/4	...	9/8		9/6 to 10/6
Miners in wet [ground]	8/4 to 10/-	8/4	...	11/-		12/- for 6 hrs
TIN—						
Labourers ...	7/6 to 8/-	7/- to 7/6	...	6/8		7/- to 8/6
Miners ...	8/4 to 9/-	7/- to 8/-	...	8/9		7/6 to 9/-
Blacksmiths ...	9/- to 10/-	10/-	...	8/9		9/- to 12/-
Carpenters ...	9/- to 10/-	10/-	...	9/3		9/- to 11/-
Engine-drivers—					Do.	
stationary ...	8/4 to 10/-	8/4	(see above)	8/3		9/- to 9/6
Shift bosses ...	10/- to 12/-	8/4 to 10/-		12/-		8/- to 11/6
Nozzlemen ...	8/4	7/- to 8/-	...	10/-		8/- to 9/6
Racemen ...	7/6 to 8/4	7/- to 7/6	...	9/-		7/- to 9/6
Face bosses ...	8/4 to 11/-	...	...	...		9/- to 13/4
Boxmen ...	8/- to 8/4	...	...	...
Sluicemen ...	7/6 to 8/-	...	...	...
COAL—						
Deputies ...	10/- to 11/-	10/-	...		14/-	8/- to 8/6
Shot firers ...	9/-	...	...		13/2	...
Shiftmen ...	6/- to 12/4	7/6 to 9/-	...		13/2	7/- to 8/-
Wheeler ...	5/- to 9/1	5/6 to 7/-	...		11/2 to 13/-	5/- to 7/-
Overmen ...	£3 to £5 week	13/4	...		On salary.	10/- to 11/8
Miners ...	10/- to 15/-	8/6	...		13/2	8/- to 10/-
Machine men ...	11/- to 14/-	7/4	...		12/10 to 14/8	8/6
Enginemmen—						
Winding ...	10/- to 11/-		(see above)	Not mined.	12/4	8/4
Hauling ...	8/- to 9/-	8/2			...	6/- to 10/-
Other ...	8/- to 10/-				...	6/- to 8/-
Labourers ...	6/- to 7/-	6/-	...		9/4 to 10/4	6/- to 7/6
Blacksmiths ...	8/- to 10/-	8/4	...		12/2 to 12/10	7/- to 8/-
Carpenters ...	9/- to 10/-	8/4	...		11/- to 12/4	6/6 to 8/-
Safety lampmen ...	8/- to 10/-	6/- to 6/6	...		...	...
Platmen or [banksmen]	8/- to 9/-	7/- to 7/4	...		11/2	6/-

GRAPHS SHEWING VALUES OF PRINCIPAL MINERALS PRODUCED IN THE
COMMONWEALTH, 1842 to 1908.



(See pages—for total mineral production, 485; gold, 488; silver, 497; copper, 503; tin, 506; coal, 516.)

EXPLANATION OF GRAPHS.—The values shewn in the above diagrams are those of the total Commonwealth production of the most important minerals in successive years from 1842 to 1908.

The base of each small square represents an interval of one year, and the vertical height represents, in the case of gold £300,000; copper, £120,000; silver, lead, etc., £100,000; coal, £40,000; tin, £25,000; and total mineral production, £800,000.

The names of the various minerals are written on the graphs which respectively represent them, and the distinctive types of line used are exhibited in detail in the central portion of the diagram.

3. **Accidents in Mining, 1908.**—The following table gives particulars of the number of men killed and injured in mining accidents during the year 1908 :—

NUMBERS KILLED AND INJURED IN MINING ACCIDENTS, 1908.

Mining for—	N.S.W.	Victoria.	Q'land.	S. Aust.	W. Aust.	Tas.*	Cwlth.†
KILLED.							
Coal and shale ...	21	1	3	...	1	...	26
Copper ...	6	...	15	...	...	...	21
Gold ...	4	19	12	2	40	...	77
Iron ...	...	...	...	...	...	...	...
Silver, lead and zinc...	19	...	...	...	...	...	19
Tin ...	3	...	3	...	...	...	6
Total ...	53	20	33	2	41	...	149
INJURED.							
Coal and shale ...	111	7	29	...	32	...	179
Copper ...	19	...	21	...	...	...	40
Gold ...	17	87	65	5	364	...	538
Iron ...	1	...	...	...	...	...	1
Silver, lead and zinc...	18	...	...	...	...	...	18
Tin ...	...	...	25	...	2	...	27
Total ...	166	94	140	5	398	...	803

* Not available.

† Exclusive of Tasmania.

§ 16. State Aid to Mining.

1. **Introduction.**—The development of the mineral resources of the several States is fostered and encouraged by the respective Governments in various ways. It is proposed to deal below only with the more direct and special methods by which assistance is rendered for developmental or other purposes, and not to include herein particulars of certain general developmental works found in nearly all civilised countries, such as geological surveys and schools of mines; there is also, as a general rule in all States, some provision for free assays for prospectors. Particulars as to the total expenditure on mining development in each State from loan funds are given in the Section of this book dealing with the subject of *State Finance* (see Section XX. § 4); it should be noted, however, that in addition considerable sums have been spent in some of the States on Government aid to mining out of the consolidated revenue.

2. **New South Wales.**—Though there is no Act in force in this State specifically relating to the provision of loans in aid of mining development and prospecting, various arrangements have been made for rendering financial assistance to prospectors and others.

(i.) *Prospecting Votes.* Since the year 1887 annual appropriations have been made by Parliament "to promote prospecting for gold or other minerals, and to encourage the opening of new goldfields." The total amount expended under these votes to the 30th June, 1909, was £398,742, while the repayments on account of advances totalled £1761,

or less than $\frac{1}{2}$ per cent. of the amount advanced. During the year 1908 aid was granted by the Prospecting Board in 235 cases, and refused in 213 cases, while the total amount expended from the vote during the year was £11,105.

(ii.) *Boring Plants.* No special provision exists in New South Wales for the expenditure of funds on boring for minerals, though on several occasions, as, for instance, where the proving of the occurrence of coal in certain localities was considered to be a question of national importance, diamond drills have been provided from special votes.

(iii.) *Government Batteries.* An amount of £5000 was provided in the year 1907 for the establishment of crushing batteries on gold and mineral fields; as yet no expenditure has been made from this amount, which is still available during the financial year 1909-10.

3. *Victoria.*—State assistance to mining in Victoria is provided for by the Mining Development Acts, 1896 to 1908. The original Act provided for the advances and grants to be made out of the sum of £140,000 raised by the issue of Treasury bonds, but an amending Act of 1898 provided that they should be paid also out of any moneys authorised from time to time. Various Acts have been passed for the appropriation of money, generally out of surplus revenue, for mining development or for special purposes in connection therewith, such as the equipment of Schools of Mines, the purchase of cyanide patents, of a metallurgical laboratory, or of boring machinery. A considerable amount of boring for the purpose of locating mineral deposits is also carried out by the Government.

(i.) *Advances to Miners for Prospecting.* Any two or more persons in combination may apply for an advance not exceeding £250 for the purpose of assisting them to prospect for any minerals or metals, and, subject to the usual evidence as to *bona fides*, undertakings to secure repayment, and proof of previous expenditure of £1 for every £1 granted, the Minister may recommend the granting of the loan.

(ii.) *Advances to Companies for Development of Mining.* Under Part I. of the Act of 1896, a company may apply for a loan for the purposes of (a) carrying on pioneer mining, (b) procuring and erecting machinery, and (c) providing all works necessary for carrying on such pioneer mining. The loans to any one company may not exceed £10,000, and are subject to the same conditions as advances to miners (see (i.) above). Under the amending Act of 1908 a sum of not more than £50,000 is authorised to be advanced by way of loan to companies for development of deep alluvial or deep quartz mining. Evidence and information must be furnished by an applicant for a loan as to the history of the company, the nature of the land upon which it is intended to carry on mining operations, the machinery and appliances which it is proposed to use, and as to the estimated cost of such machinery; and a statement must be provided shewing the period of time over which the advance is to extend. Applications are referred by the Minister to the Government Geologist for report and are then dealt with by the Executive Council. Interest on loans at the rate of $3\frac{1}{2}$ per cent. per annum must be paid half-yearly, and the payments to the Treasurer form a first charge on the profits and assets, except uncalled capital, of the company.

(iii.) *The Establishment of Plant for Testing Metalliferous Material.* Government testing plants may be established only in districts where there is no battery where ore is crushed or dealt with for payment. If the Minister be of opinion that there is a necessity in the interest of the mining industry for the establishment of a testing plant in any district, he may submit to the Treasurer such evidence as in his opinion is sufficient to justify the expenditure necessary to procure and erect the same, and the Treasurer may recommend the Governor to grant, and the Governor may grant, the necessary funds. The purchase, transport, erection, and removal of any testing plant, and the rates to be charged for its use must be in accordance with regulations made under the Act.

Of the twenty batteries which had been erected by the Government up to the end of the year 1908, ten have been managed by local committees, without expense to the Mines Department as far as the cost of working is concerned, while the remaining ten were worked directly under the supervision of departmental officers. The quantity of ore crushed during 1908 at the batteries owned by the Government was 3137 tons for a yield of 2373½ ozs. of gold, shewing an average of 15.13 dwts. per ton. The total cost of working and maintenance during the year amounted to £2371, and the sum received from the public for crushing was £536, giving a net cost of £1835. From 1897, when the first battery was erected, to the end of 1908, a total of 30,179 tons, yielding 18,397 ozs., has been treated.

Diamond drills are hired by the Government under specified conditions to companies at a rental of from £2 to £4 per month according to size and kind of drill, £200 being lodged as security to cover breakages, and hand-boring plants are also hired under similar conditions at a rental of 10s. per month.

(iv.) *Construction of Roads and Tracks for Mining.* Under Part II. of the Act of 1896 the Minister may, subject to certain conditions, on the application of the council of any shire situated in an outlying or mountainous part of Victoria, construct a road suitable for the transport of mining machinery and appliances to any locality where mining is being carried on by more than one company, or by holders of miners' rights.

(v.) *Construction of Races and Dams.* Under Part IV. of the Act of 1896 the Minister is empowered, subject to the report of the Government Geologist and the Chief Engineer of Water Supply, and to the approval of the Treasurer and Governor in Council, to construct races and dams for working alluvial deposits for gold, to divert water for such uses subject to all existing rights, and to make regulations for the payment of rates for the use of the water.

(vi.) *Dissemination of Information.* Part VI. of the Act of 1896 provides that if the Minister be of opinion that it is advantageous to expend money for the purpose of disseminating information in Great Britain and other countries as to the mining resources of Victoria, and for holding in Victoria a public exhibition of mining machinery and appliances, he may recommend the Governor through the Treasurer to grant moneys necessary for the purpose.

(vii.) *Expenditure on Government Aid to Mining.* The following statement shows the total expenditure under the Mining Development and Surplus Revenue Acts up to the end of the year 1908 :—

**VICTORIA.—EXPENDITURE ON GOVERNMENT AID TO MINING
TO END OF YEAR 1908.**

Particulars.	Advances to Mining Com- panies.	Advances to Pros- pectors.	Boring for Gold and Coal.	Roads and Tracks.	Erection of Testing Plants.	Mis- cellaneous.	Total.
Amount	£ 100,033	48,801	57,651	68,648	21,012	47,259	343,404

In addition, the expenditure from votes from the 30th June, 1904, to the 30th June, 1908, was £46,905 on boring for gold and coal, and £9768 on testing plants.

The repayments by companies of the loans advanced amounted on the same date to £16,757, and by parties of miners to £1735. A sum of £5974 has been repaid for part of the cost of boring, and also hire of plant and loss of diamonds. Several companies have discontinued operations, and their security in the way of plant was taken possession of and sold for a total of £8448. The amount of loans was, however, £19,924, and thus a loss of £11,476 was incurred.

4. **Queensland.**—Special assistance granted to the mining industry in this State may be conveniently dealt with under the headings specified below:—

(i.) *Assistance to Prospectors.* Assistance is granted in connection with sinking wells and providing equipment or rations for small parties of miners, and in some cases for prospecting or developing lodes. Such assistance is granted directly by the Minister, sometimes to a local authority, sometimes through the warden, and sometimes to miners or progress associations.

(ii.) *Grants for Roads and Bridges to Gold and Mineral Fields.* These grants are made either for the purpose of repairing existing roads and bridges or of constructing new ones; they are made with Executive approval, generally to local authorities.

(iii.) *Loans in aid of Deep Sinking.* These loans are made with the approval of the Executive in order to prove lodes at a depth or for diamond drilling.

(iv.) *The Mining Machinery Advances Act 1906.* Under this Act loans may be made for (a) procuring and erecting machinery for carrying on mining operations, or (b) procuring, erecting, or removing and re-erecting plant for treating minerals. Loans are granted by the Minister on the approval of the Governor in Council, interest at a rate not exceeding 5 per cent. per annum being charged. There is no limit to the amount which may be advanced, but the borrower must contribute £1 for £1 towards the work for which the loan is granted. The borrower must also execute a bill of sale or mortgage over the machinery or property, but the moneys advanced are not recoverable against the borrower personally, but only against the secured property.

(v.) *Amounts Granted or Advanced, 1908.* The total amount granted or advanced under the several systems above mentioned to the end of 1908 was as follows:—

QUEENSLAND.—PARTICULARS OF AMOUNTS GRANTED OR ADVANCED, 1908.

Purposes for which Granted, etc.	Prior to 1908.	During 1908.	Total to end of 1908.
	£	£	£
Assistance to prospecting	24,605	3,800	28,405
Grants for roads and bridges	11,600	1,921	13,521
Loans in aid of deep sinking	42,816	6,633	49,449
Advances under Act of 1906 ... ..	...	2,450	2,450
Total	79,021	14,804	93,825

In addition special sums are occasionally granted or advanced in certain cases; for example, in 1908 sums of £2460 and £306 were advanced for the purposes of oil boring and coal prospecting, respectively.

5. **South Australia.**—By regulations made under Part VI. of the Mining Act 1903 in February, 1894, as amended in January, 1899, provision is made for State aid to mining by way of:—(i.) Rewards to discoverers, (ii.) subsidies, and (iii.) loan of boring plant.

(i.) *Rewards to Discoverers.* Rewards may be paid to the discoverer (being the holder of a miner's right) of any new mineral district, or of any new and valuable deposits of metals, minerals, coal, or oil. The amount of the reward depends upon the distance of the discovery from the nearest payable mineral deposits already worked, and upon the number of men employed on the new field within six months after the report of the discovery has been made; the reward may not in any case exceed £1000. No rewards have yet been granted.

(ii.) *Subsidies.* Applications for subsidies may be made by any person engaged in deep sinking, prospecting, or mining. No subsidy may exceed 100 per cent. on the

amount proposed to be expended by the applicant, and the total grant to any one person or company may not exceed £1000. Fifty per cent. of the net profits must be applied in payment of the subsidy, and a bill of sale of all chattels belonging to the applicant and used in connection with the mine must be executed. If an applicant for assistance is mining on private land, the granting of a subsidy is subject to additional conditions. The total amount advanced by subsidies up to the 30th June, 1909, was £49,244; the number of individual persons or companies to whom subsidies were granted was ninety-nine, while the total repayments to date amounted to £6,092.

(iii.) *Loan of Boring Plant.* The regulations also provide for the loan of diamond drills. There are two Government boring plants in South Australia, the capital expenditure thereon up to the 30th June, 1909, amounting to £6057.

(iv.) *Government Batteries and Cyaniding Plants.* There are four Government batteries and cyanide works in South Australia, the capital cost thereof amounting to £14,319. Up to the end of the year 1908 the total quantity of ore treated by these plants amounted to 16,194 tons, from which 12,067 ounces of gold, valued at £44,237, were extracted.

6. **Northern Territory.**—In the Northern Territory, Government assistance in the form of free rations is granted to prospectors and free assays are made. There are three Government boring plants, and two batteries and cyanide plants (both the latter being situated in the Macdonnell Ranges). The total amount of ores treated at the batteries up to the end of 1908 was 10,060 tons, from which 12,162 ounces of gold, valued at £45,219, were recovered.

7. **Western Australia.**—In this State, Government aid to mining is provided both under the Mining Development Act 1902 and under a more general vote for developmental purposes. A large amount of general developmental work has been carried out by the Government, particularly in regard to water supply; particulars of the eastern goldfields water-supply scheme may be found in the section of this book dealing with *Water Conservation and Irrigation* (see Section XIV. § 1). The Act of 1902, referred to above, is in many respects similar to the Victorian Act of 1896; its chief provisions may conveniently be considered under the headings indicated below.

(i.) *Advances to Prospectors.* The Minister may, after obtaining a report from a professional officer, grant a loan not exceeding £300 to any miner who applies for assistance to enable him to prospect for gold or minerals. An applicant must furnish the necessary descriptions, statements, and information, verified by statutory declarations, and for every £1 advanced the borrower must expend £1 in work, labour, or material.

(ii.) *Advances for Pioneer Mining.* The purposes for which, and the conditions upon which, advances may be made are similar to those specified under Part 1 of the Victorian Act of 1896 (see 3 ii. above); the amount advanced to any one borrower is limited to £1000.

(iii.) *Establishment of Testing Plants.* Plant for crushing, ore-dressing, cyaniding, or smelting, may either be established by the Minister or he may subsidise companies who are willing to erect and work such plant for the public at prescribed rates. Any such plant may only be erected in a district (a) in which large deposits of ore exist, (b) where existing plant for treating deposits in bulk at reasonable rates is not available, and (c) where the establishment of such plant is necessary for the development of mining.

In 1908 there were twenty-nine State batteries and twenty-two cyanide plants in operation; there were also three slime plants and two tin-dressing plants. The total amount expended on the erection of State batteries up to the end of 1908 was £90,231 from revenue, and £160,853 from loan, giving a total of £251,084. The following statement shews the receipts and expenditure for the year 1908:—

**WESTERN AUSTRALIA.—RECEIPTS AND EXPENDITURE OF GOVERNMENT
BATTERIES AND TESTING PLANTS, 1908.**

Plant	Batteries.	Cyanide.	Slimes.	Tin.	Total.
	£	£	£	£	£
Receipts	44,470	27,780	3,546	969	76,765
Gross Expenses	58,140	18,343	3,513	1,222	81,218

The amount shewn for total gross expenses above is exclusive of £1573 for head office and inspection expenses of cyanide and slimes plant, and also of £1252 for additions paid from revenue; the total loss on the year's working was therefore £7278.

The total value of gold and tin produced to the end of 1908 at the State plants was £2,747,425. The tonnage of stone milled during the year was 95,623 tons, producing 89,875 ozs. of gold by milling. At the commencement of 1908 a uniform charge of ten shillings per ton was instituted at gold ore plants, a reduction of nearly two shillings per ton on the average rates previously charged.

(iv.) *Assistance for Boring.* Subject to certain conditions the Minister may agree to pay not more than half the cost of boring either for gold, minerals, or water, and with the approval of the Governor and after receiving a report from the proper officer that such boring is in the general interest of the State, he may pay the whole cost.

(v.) *Miscellaneous.* The Minister may advance or himself expend moneys (a) to drain any area, (b) to assist mining by sinking or cross-cutting, (c) to sink shafts for minerals at great depths, and (d) to provide means of transport for miners to prospect unproved country.

(vi.) *Particulars of Advances, 1908.* The following statement shews the sums advanced during the year 1908 under the provisions of the Mining Development Act:—

**WESTERN AUSTRALIA.—ADVANCES MADE IN 1908 UNDER MINING DEVELOPMENT
ACT 1902.**

Particulars.	Advances in aid of Mining Work and Equipment of Mines.	Advances in aid of Boring.	Subsidies to Crushing Plants.	Purchase of Boring Plants.	Providing Means of Transport.	Total.
Amount £	8,446	1,038	2,076	1,596	2,002	15,158

In addition to the above, amounts totalling £1338 were expended from the Mining Development Vote on various matters, such as water supply, roads, subsidies to assist cartage of ore, drainage, timber tramways, and subsidies for development work done below the 100 feet level in small mines. The receipts under the Act, exclusive of interest payments, amounted to £539 for refunds of advances, and £1560 for sales of plant, a total of £2099.

8. *Tasmania.*—The only provision made in Tasmania for State aid to mining is under the Deep-Sinking Encouragement Acts 1899, 1900, and 1901. Under these Acts sums of £5000, £2000, and £1000 respectively were provided for assisting persons and companies to sink shafts or to drive tunnels below a specified depth, the amount advanced in any particular case varying according to the amount expended by the borrower. The total amount advanced to October, 1909, was £6861, granted to five companies in sums ranging from £682 to £1452, leaving an unexpended balance of £139. None of the companies to whom the advances were made have been successful, and consequently none of the sums advanced, which were to be repaid out of profits, have been refunded.