

## MINERAL RESOURCES.

**A**LMOST all the principal metals of economic value are found in Australasia, and many are common to several of the States. In dealing with the occurrence and value of mineral deposits, a classification has been made into noble and other metals, carbon minerals, salts, stones and clays, and diamonds and other gem stones.

### GOLD.

Gold, the most valuable of noble metals, is found throughout Australasia, and the important position at present occupied by these States is largely due to discoveries of this metal, the development of other industries being, in a country of varied resources, a natural sequence to the acquisition of mineral treasure. Settlement in Australia was still young when many-tongued rumour spoke of the existence of the precious metal, but it was not until the 16th February, 1823, that the Government was officially apprised of a discovery destined to be the precursor of a prosperity seldom surpassed in the history of nations. On the date mentioned Mr. Assistant-Surveyor M'Brien reported that at a spot on the Fish River, about 15 miles east of Bathurst, he had discovered gold. Mention is made in the early records of New South Wales of several other finds, but it remained for Count Strzelecki and the Rev. W. B. Clarke to demonstrate the existence of the precious metal in payable quantities, and to assert their belief in its abundance, an opinion strongly supported in England by several eminent authorities, and substantiated by Hargraves' discovery in the year 1851. The gold-fields of Lewis Ponds and Summer Hill Creek had hardly been opened up when, on the day that witnessed the severance of the Port Phillip district from the mother colony of New South Wales, Mr. J. M. Esmond discovered gold in Victoria. Shortly afterwards a rush set in for Ballarat, and the gold fever took possession of Australia. The following year (1852) saw gold found in South Australia, Tasmania, and New Zealand, though it was not until 1861 that a large population was, by the prospect of rapidly obtaining wealth, attracted to the last-mentioned colony. The rush to Canoona, in what is now Queensland, took place in 1858. The last of the States in which extensive deposits of the precious metal were found was Western Australia, but the mines there are now the richest in Australasia, and have proved an enormous source of wealth to the state.

From the date of its first discovery, gold to the value of nearly 476 million pounds sterling has been obtained in Australasia. Towards this total Victoria has contributed 263½ millions, and for many years that state was the largest gold producer of Australasia. In the year 1897, however, for the first time, the production was surpassed by that of Western Australia, and the latter state increased its advantage each year until in 1902 the output was valued at £7,947,662, as against £3,062,028 in Victoria. The yield of gold in Victoria has been well maintained for many years, and each successive year from 1893 to 1899 showed an increase. In the last-mentioned year the production was 854,500 oz., valued at £3,418,000, but during the last three years there has been a decline, and the output in 1902 amounted to only 777,738 oz., or 720,866 oz. fine, valued at £3,062,028. The Bendigo district was again the chief centre of production, with 190,165 oz., followed by Ballarat with 172,599 oz., and Beechworth with 96,518 oz. The richest fields in the state are at Bendigo and Ballarat which, after yielding uninterruptedly for half a century, still give no evidence of depletion. The output of the former field in 1902 was 184,959 oz., and of the latter 62,712 oz. Of the total yield of the state 33,109 oz. were obtained by means of dredging and hydraulic sluicing. There were 11 dredges and 29 sluicing plants in operation at the close of the year, and their value was estimated at £270,000, the number of men employed in connection with them being 956. The total number of men engaged in gold-mining on the 31st December, 1902, was 26,103, of whom 11,963 were alluvial miners, and 14,140 quartz miners. The machinery and plant in use on the same date were valued at £1,958,560.

Queensland promised at one time to overtake Victoria in the annual production of gold, but so far the southern state has maintained its position, although the production of Queensland advanced steadily up to the year 1900. In 1889 the output was valued at £2,586,860, but thenceforward the yield declined, and this amount was not again reached until 1898, when the value was £2,750,349. During the next two years there was again an increase, the value of the gold won in 1900 being £2,871,709, the highest yet recorded. The production in 1901 was 589,382 oz. fine, valued at £2,541,892, while in 1902 it amounted to 640,463 oz. fine, with a value of £2,720,639. The decreased output of the past two years is not due to the waning productiveness of the mines, as the yield of 1902 is the largest obtained from stone raised and reduced in any one year. Although the yield in 1900 was higher, it included a considerable quantity of gold obtained from old tailings, and from creeks which had served as channels for the escape of residue from the mills. Want of water hampered operations in 1902, especially at Mount Morgan; nevertheless, great activity was displayed in gold-mining circles, and, encouraged by the increased dividends paid, many new ventures were launched, while developmental work at established mines was prosecuted with renewed vigour.

Arranged in order of productiveness, the principal goldfields in Queensland in 1902 were Charters Towers, Mount Morgan, and Gympie, while Ravenswood and Croydon also produced a considerable quantity of the precious metal. For many years Charters Towers has been the chief gold-producing centre, and the year 1902 was perhaps the most prosperous experienced on the field since its discovery in 1872. The production in 1902 amounted to 265,244 oz. fine, valued at £1,126,735, or £127,190 more than in the preceding year. There are three great ore shoots on this field, known as The Day Dawn, Brilliant, and Victoria Reefs, and the rich developments in the Queen Cross, one of the mines engaged in working the Victoria reef, was mainly responsible for the increased activity in the mining operations. The dividends paid by this mine during the year amounted to £111,666, and present appearances indicate that the yield of last year will be fully maintained during the present year. Of the mines engaged on the Day Dawn reef, the most important in point of production was the Day Dawn Block and Wyndham, which returned dividends amounting to £49,840 during the year. In consequence of the success attending the operations of the mines on this reef, two new mines were started in 1902 which hope to strike the Day Dawn reef at depths of 2,600 feet and 2,500 feet respectively. The Brilliant Central was the most productive and profitable mine of the Brilliant group, and paid £68,750 in dividends during 1902. Scarcity of water has hitherto retarded operations at Charters Towers, and in order to secure a constant supply a weir was constructed across the Burdekin River. Shortly after its completion a flood occurred most opportunely in the river, and no less than 400,000,000 gallons of water were impounded. By an arrangement with the Railway Commissioners, who provided a daily supply of 200,000 gallons of water, the Mount Morgan mine was enabled to carry on operations during the dry period of 1902. The yield of this field for the year amounted to 142,826 oz. of fine gold, valued at £606,714, or £8,965 less than in the preceding year. The Mount Morgan mine was responsible for almost the whole of the production, and yielded 145,347 oz. of gold, with a value of £585,007, obtained from 218,214 tons of stone. Up to the 31st May, 1903, no less than 2,624,319 oz. of gold, valued at £10,652,339, had been obtained from this mine. During the year a large body of ore was located at the 750-foot level, a depth much lower than that from which stone has hitherto been raised. The machinery employed at the Mount Morgan mine on the 31st December, 1902, was valued at £517,229, and about 1,700 hands were engaged at the mine and works. The yield of the Gympie mining district, in 1902, surpassed that of any previous year, and amounted to 120,662 oz. fine gold, with a value of £512,562. The chief contributing mines were the No. 2 South Great Eastern, Scottish Gympie, and South Glanmire and Monkland, which produced 44,571 oz., 36,003 oz., and 33,188 oz. of gold, and paid dividends amounting to £98,800, £50,250, and £79,500 respectively.

The deepest mine on the field was the West of Scotland, which is down 3,000 feet, while several others exceed 2,000 feet in depth. This field gives employment to 1,740 quartz miners, and 22 alluvial miners, and the machinery in use is valued at £247,000. The Ravenswood gold-field, which had been comparatively neglected for some years, has again attracted attention owing to rich discoveries made in 1902, and the production last year showed a considerable advance on that of 1901, amounting to 40,969 oz. fine gold, valued at £174,034. The Sunset is the principal mine in the locality, and during the year produced 21,978 oz. of gold, valued at £90,000. There were 849 miners working at the end of 1902, of whom 806 were engaged in gold-mining. The yield of the Croydon field amounted to 28,355 oz. fine gold, valued at £120,451. The number of men employed on the 31st December, 1902, was 500, and the machinery in use was valued at £73,600. The total number of men engaged in gold-mining in Queensland at the end of 1902 was 9,045, of whom 7,129 were quartz-miners and 1,916 alluvial miners, 560 of the latter being Chinese.

In New South Wales the greatest annual production of gold occurred in 1852, soon after the first discovery of the precious metal, when the output was valued at £2,660,946. The only other year which saw a production in excess of two millions sterling was 1862, when the return reached £2,467,780. In 1874 the yield had fallen to 271,166 oz., valued at £1,041,614, and thenceforth the industry declined considerably in importance, reaching its lowest point in 1888, when only 87,541 oz., valued at £317,241, were produced. From that date onward there was a steady improvement, and in 1894 the Government took the step of furnishing large numbers of the unemployed with miners' rights and free railway passes, and sending them to the abandoned alluvial fields as fossickers. This action, with the increased attention paid to quartz-mining, nearly doubled the production, the quantity obtained during the year being set down at 324,787 oz., valued at £1,156,717, being the first time since 1874 that it had exceeded one million sterling; while in 1895 the yield reached 360,165 oz., and the value £1,315,929. During the next three years there was a falling off, but in 1899 the output reached the value of £1,623,320, the highest since 1872. From that year onwards want of water was responsible for a diminished production. The value of the yield in 1902 was £684,970, and the total up to the end of that year £49,844,135. The figures now published referring to the years 1897 to 1901 include gold obtained from native ores only, and differ from those shown in previous editions of this work, which included also gold obtained from imported ores. The yield of gold for 1902 is the lowest since 1893, but this is accounted for by the fact that want of water caused many of the mines to shut down for more than half the year. Of the gold produced in 1902, 25,473 oz., valued at £97,891, were obtained by dredging, the output from this branch of the industry showing an increase of £8,263 on that of the previous year. On the 31st December, 1902, there were 36

dredging plants in commission, valued at £262,700, while 5 others, which had been working unsuccessfully, were in course of removal to more favourable sites. The area held and applied for under lease for gold dredging was 11,719 acres. The principal seats of alluvial mining in the State are the Bathurst, Mudgee, Tumut and Adelong, and Braidwood districts, together with the country watered by the various feeders of the Upper Lachlan; while the principal quartz-veins are situated near Adelong, Armidale, Bathurst, Cobar, Hill End, Orange, Parkes, and Wyalong. Cobar again maintained the position occupied in preceding years as the chief gold-producing centre, the output for 1902 being valued at £90,200. The next in importance was Wyalong, with £77,046; followed by Araluen £53,155, and Adelong £51,700. The mines in this State are not so productive as those of Western Australia or Queensland, the largest yield from any one mine in 1902 being 9,808 oz., valued at £34,142. This was obtained from the Gibraltar mine in the Adelong district, while the Myall United, situated near Peak Hill, produced 7,829 oz., valued at £30,486, and the Lachlan Gold-fields, Limited, 5,542 oz., valued at £22,103. Of the mines recently developed, that at Mount Boppy, near Cobar, is by far the most promising. The lode is 5 feet and upwards in width at a depth of 300 feet, and samples taken from it averaged 79·70 dwt. to the ton. The estimated value of the machinery on the gold-fields, including dredging plant, at the end of 1902 was £992,742. The men engaged in the industry numbered 10,610, of whom 5,176 were quartz miners and 5,434 alluvial miners, the latter including 336 Chinese.

Until a comparatively recent date, Western Australia was considered to be destitute of mineral deposits of any value, but it is now known that a rich belt of mineral country extends from north to south. The first important discovery was made in 1882, when gold was found in the Kimberley district, but it was not until a few years later that this rich and extensive area was developed. In 1887 gold was found at Yilgarn, about 200 miles east of Perth, the find possessing importance as the precursor of the discovery of the immense tracts of gold-bearing country, the knowledge of the existence of which has drawn population from all parts of Australasia and brought the state into the prominent position which it occupies at the present time. General attention was first attracted to these fields by further discoveries at Southern Cross, to the east of Yilgarn; and the sensational finds at Coolgardie, which followed in 1892, resulted in a rush to Western Australia which was reminiscent of the experiences of the fifties in the older-settled portions of the continent. Thereafter, before the march of the prospector, the known gold-bearing area was rapidly extended, and in 1894 the country was divided into separate gold-fields, so extensive were the preparations for its exploitation. At the present time, there are nineteen gold-fields in the state, the most important, from the point of production in 1902,

being East Coolgardie, Mount Margaret, and North Coolgardie, in the eastern district; and Murchison, in the central district. For the past five years Western Australia has held the premier position among the Australian States in regard to gold production, and the annual output is still increasing. The production during 1901 was 1,879,391 oz., representing 1,703,417 oz. fine, with a value of £7,235,653, and ranked as the highest recorded up that year; but this return was exceeded in 1902 when the production amounted to 2,177,441 oz., or 1,871,037 oz. fine, valued at £7,947,662. Of the total yield, no less than 1,172,405 oz. were obtained from the East Coolgardie field, where some of the richest mines in the world are to be found. Those which contributed chiefly to the large output were the Great Boulder Perseverance, 193,297 oz.; Golden Horseshoe, 192,573 oz.; Great Boulder Proprietary, 166,518 oz.; and the Ivanhoe, 142,298 oz. The Mount Margaret and Murchison gold-fields produced 216,637 oz. and 212,570 oz. respectively, while 187,273 oz. were obtained from North Coolgardie. The dividends returned by some of the gold-mining companies in 1902 were enormous, the total being £1,424,272. Of this amount the Great Boulder Perseverance paid £350,000, the Golden Horseshoe £270,000, and the Great Boulder Proprietary £218,750. The importance of the gold-mining industry to Western Australia may be gauged from the fact that the number of men engaged therein at the end of 1902 was 20,476, comprising 15.67 of the whole male population, while the machinery in use was valued at £4,304,397.

Although gold was discovered in New Zealand at Coromandel during the year 1852 there is no record of the production prior to 1857, when there was an export valued at £40,422. For many years the colony was a large producer of gold, and from 1865 to 1871 the value amounted to over £2,000,000 each year. The production then declined and in 1894 it was only £887,839, but this amount has been considerably increased of late years, and in 1902 the total amounted to 508,045 oz., valued at £1,951,433, the highest recorded since 1873. Up to the 31st December, 1902, gold to the value of £61,111,316 has been raised in the colony. The largest proportion of the yield in 1902 was obtained in the Auckland district; the value of the gold entered for exportation from each district being:—Auckland, £721,977; Otago, £728,124; West Coast, £475,272; Nelson, £23,649; Marlborough, £2,404; and Canterbury, £7. In the early years the gold was obtained from alluvial diggings, but at the present time much is obtained from quartz reefs, which are widely distributed throughout New Zealand. The Auckland district is the principal seat of quartz mining in the colony, and the chief centre of production is at Waihi. The only mine on this field which has reached the productive stage is that of the Waihi Gold-mining Company, from which gold to the value of £520,138 was obtained during 1902. The company paid dividends to the amount of £208,645 during the year, the total paid since the commencement of operations being £1,005,934. From the mines at Karangahake gold

valued at £107,362 was won, but the yield from the Thames and Coromandel fields was small. At Thames only tributors and small mining parties are now at work, but at Coromandel renewed interest has been infused into mining operations by the discovery of some rich gold-bearing patches in 1902. From the Reefton district in the Middle Island gold to the value of £188,839 was obtained during 1902. Considerable attention is directed to the recovery of gold by dredging, and at the end of 1902 there were 201 dredges in operation, while there were 37 in course of construction or removal and 52 out of commission. The number of men engaged in gold-mining at the end of 1902 was 11,398, and the machinery in use was valued at £2,082,384.

Although payable gold was found in Tasmania in 1852, it was not until the seventies that the metal was mined for on an extensive scale, the total production to the end of 1870 being less than 4,000 oz. In 1878 the value of gold produced suddenly rose to £100,000, and this total has been gradually increased, until in 1899 it was valued at £327,545, being the highest yet recorded. The production in 1902 amounted to 70,996 oz. fine, valued at £301,573, and showed an increase of £6,397 on the value of the preceding year. Beaconsfield is the principal gold-field in the State. It is situated on the west side of the river Tamar, 26 miles north-west of Launceston, and formerly produced a large quantity of alluvial gold, while there is also a rich deep lead. The Tasmania mine, on this field, is the largest gold-producer in the state, and up to 30th June, 1903, yielded 569,778 oz., valued at £2,090,938, out of which £772,072 has been paid in dividends. The Lefroy field has been another important centre of gold-production, but although payable gold is still obtained the yield is not nearly so large as in former years. At Mathinna a large quantity of gold has also been obtained. The principal mine on this field is the New Golden Gate, the deepest in the state, its main shaft being 1,500 feet. This mine has yielded 191,357 oz. of gold, valued at about £730,599, and up to 30th June, 1903, had paid £326,400 in dividends. From the Volunteer Consolidated Mine on this field some good stone has been obtained from two lodes struck at a depth of 450 feet. In the Western District a little alluvial gold is obtained, while north of the Pieman River there is a large extent of auriferous country, but owing to the dense vegetation prospecting is difficult. Attempts are being made on the Whyte River to recover gold by the process of dredging, but as the results have not been satisfactory, the dredge is to be transferred to the Pieman River. The men engaged in gold-mining during 1902 numbered 1,038.

Of all the Australian States, South Australia has produced the smallest quantity of gold, the total output from the commencement of mining operations being valued at less than £2,500,000. The highest production was in 1893, when it reached £153,132; but it has gradually declined, and the value has not amounted to £100,000 in any of the last five years. In the state proper the yield is very small, amounting to but 7,245 oz. in 1902, the balance of 20,967 oz. being

obtained from the Northern Territory, the total value amounting to £95,129. Some excitement was caused during 1902 by reports of a rich discovery at Arltunga, and visions of easily acquired wealth caused the usual rush of gold seekers. The field, however, proved most disappointing, and although a mild boom in Arltunga shares existed for a few weeks, it did not long survive the discouraging reports received from the scene of operations. Gold undoubtedly exists in considerable quantities, but capital is required for its exploitation. A report by the Government Geologist states that with good management and economic mining and treatment of the ore large and payable returns may be obtained for many years. The mines in the Northern Territory are largely in the hands of Chinese, but a number of properties have been acquired by an English company, which has erected the works necessary for their development. The total number of men engaged in gold-mining in South Australia at the end of 1902 was 2,000. A considerable number of these are Chinese, physically incapable of doing a fair day's work, and dangerous from a sanitary point of view. Possessed of no means whatever, and with no proper tools adapted to the search for the precious metal, they eke out a miserable existence by mining a little alluvial gold.

The following table gives the value of gold raised in each State up to the end of 1902, with the proportion of the total amount:—

State.	Production of Gold.	
	Value.	Proportion raised in each State.
	£	per cent.
New South Wales .....	49,844,135	10·48
Victoria .....	263,551,229	55·39
Queensland .....	55,472,314	11·66
South Australia .....	2,483,326	0·52
Western Australia .....	38,097,374	8·01
Tasmania .....	5,195,161	1·09
Commonwealth .....	414,643,539	87·15
New Zealand ... ..	61,111,316	12·85
Australasia .....	475,754,855	100·00

It will be readily understood from this and the following table how Victoria, although in area the smallest of the group with the exception of Tasmania, achieved the foremost position amongst the Australasian



States, and retained that place so long as the powerful attraction of gold continued, while the source of Western Australia's progress is also fully disclosed. The following table shows the value of the gold raised in the various States during each year for which records are available, but, for reasons which are explained in the next paragraph, discrepancies exist in the total values shown for several of the States:—

Year.	New South Wales.	Victoria.	Queensland.	South Australia.	Western Australia.	Tasmania.	Commonwealth.	New Zealand.
	£	£	£	£	£	£	£	£
1851	468,336	580,548	.....	.....	.....	.....	1,045,884	.....
1852	2,660,946	10,953,936	.....	.....	.....	.....	13,614,882	.....
1853	1,781,172	12,600,084	.....	.....	.....	.....	14,381,256	.....
1854	773,200	9,568,260	.....	.....	.....	.....	10,341,469	.....
1855	654,594	11,172,200	.....	.....	.....	.....	11,826,854	.....
1856	689,174	11,942,040	.....	.....	.....	.....	12,632,114	.....
1857	674,477	11,046,268	.....	.....	.....	.....	11,720,745	40,422
1858	1,104,175	10,112,908	.....	.....	.....	.....	11,217,083	52,464
1859	1,250,127	9,122,868	.....	.....	730	.....	10,382,725	28,427
1860	1,465,373	8,626,800	.....	.....	.....	.....	10,092,173	17,685
1861	1,806,171	7,869,812	.....	.....	.....	.....	9,675,983	751,873
1862	2,467,780	6,633,124	.....	.....	12,442	.....	9,113,346	1,591,889
1863	1,796,170	6,508,420	30,000	.....	880	.....	8,335,470	2,431,723
1864	1,304,026	6,181,748	.....	.....	.....	.....	7,486,674	1,856,837
1865	1,231,243	6,172,752	.....	.....	.....	.....	7,403,995	2,226,474
1866	1,116,404	5,913,120	79,143	.....	.....	.....	7,113,049	2,844,517
1867	1,053,578	5,732,084	170,090	.....	.....	4,382	6,959,188	2,098,862
1868	994,665	6,536,800	429,907	2,936	.....	.....	7,964,822	2,504,326
1869	974,149	5,349,184	451,352	15,593	.....	614	6,797,753	2,362,995
1870	931,016	4,891,192	351,412	24,217	.....	514	6,212,065	2,157,585
1871	1,250,485	5,421,908	504,876	6,000	.....	16,055	7,109,324	2,787,520
1872	1,644,177	5,130,084	592,993	6,363	.....	15,309	7,388,926	1,731,261
1873	1,396,375	4,964,820	555,310	293	.....	18,390	6,935,188	1,987,425
1874	1,041,614	4,623,888	561,255	4,175	.....	18,491	6,249,423	1,505,331
1875	877,694	4,383,148	596,242	7,034	.....	11,982	4,571,893	1,407,770
1876	613,190	3,855,040	660,136	9,888	.....	44,923	5,183,177	1,284,322
1877	471,448	3,238,612	833,544	.....	.....	23,289	4,571,893	1,496,080
1878	430,200	3,101,088	1,085,864	1,225	.....	100,000	4,718,377	1,240,179
1879	407,219	3,009,946	1,009,946	90	.....	230,895	4,683,938	1,148,108
1880	444,253	3,316,484	934,976	.....	.....	201,297	4,807,010	1,227,252
1881	573,582	3,435,400	948,318	112,825	.....	216,901	5,287,026	1,080,790
1882	526,522	3,594,144	787,125	80,720	.....	187,337	5,175,848	1,002,720
1883	458,530	3,240,188	744,731	87,729	.....	176,442	4,707,620	993,352
1884	396,059	3,114,472	1,077,314	93,404	.....	160,404	4,641,653	921,797
1885	378,065	2,940,872	1,088,294	83,709	.....	155,309	4,851,849	943,615
1886	366,294	2,660,784	1,193,493	95,674	1,148	117,250	4,434,643	903,569
1887	394,679	2,471,004	1,490,730	138,302	18,517	158,533	4,671,065	811,100
1888	317,241	2,500,104	1,685,750	66,160	13,273	147,154	4,887,300	801,066
1889	434,784	2,459,856	2,586,860	76,780	58,872	119,703	5,736,355	808,549
1890	460,285	2,354,244	2,137,054	106,105	86,064	87,114	5,231,466	773,433
1891	559,231	2,305,600	2,017,536	125,529	115,182	149,816	5,272,894	1,007,488
1892	575,290	2,617,824	2,154,453	139,370	226,284	174,070	5,837,300	954,744
1893	651,286	2,684,504	2,159,290	153,132	421,385	145,875	6,215,472	913,133
1894	1,156,717	2,694,720	2,378,289	152,692	787,099	225,485	7,394,402	887,839
1895	1,315,929	2,960,944	2,210,887	128,792	879,748	212,329	7,708,029	1,162,164
1896	1,073,360	3,220,348	2,241,347	112,759	1,068,808	237,574	7,954,196	1,041,423
1897	1,104,315	3,251,064	2,553,141	120,044	2,564,977	289,241	9,882,782	930,204
1898	1,201,743	3,349,028	2,750,349	95,143	3,990,698	281,485	11,068,446	1,080,691
1899	1,623,320	3,418,000	2,888,119	79,041	6,246,733	327,545	14,532,758	1,513,173
1900	1,070,920	3,229,628	2,871,709	82,188	6,007,010	316,220	13,578,275	1,439,602
1901	737,164	3,102,753	2,541,892	93,222	7,235,653	295,176	14,005,860	1,753,783
1902	684,970	3,062,928	2,720,639	95,120	7,947,662	301,573	14,812,001	1,951,433

These figures do not in all cases add up to the total value of the production given elsewhere, as the information regarding earlier years is

imperfect. The total for Victoria is £297,952 less than the actual value of production, while for Queensland the amount is deficient to the extent of £3,442,948, accounted for by the fact that prior to 1878 the figures only represent the gold sent by escort. There is a deficiency of £68,611 in South Australia which cannot be traced owing to the imperfect nature of the returns available in earlier years. The figures shown for Western Australia are £427,061 less than the total value of gold produced, as prior to 1899 they only show the value of gold exported. There is also a deficiency of £2,869 in the total shown for Tasmania. The information relating to New South Wales for the years 1897 to 1901 inclusive differs from that previously published, which included gold won from other than native ores. The gross production of gold in each State during 1902 and the contents in fine gold are given below:—

State.	Weight of Gold.		Value of Gold.	
	Gross.	Fine Gold.	Total.	Proportion raised in each State.
	oz.	oz.	£	per cent.
New South Wales .....	190,316	161,256	684,970	4·08
Victoria .....	777,738	720,866	3,062,028	18·27
Queensland .....	860,453	640,463	2,720,639	16·23
South Australia .....	28,212	22,395	95,129	0·57
Western Australia.....	2,177,441	1,871,037	7,947,662	47·41
Tasmania .....	.....	70,996	301,573	1·80
Commonwealth .....	.....	3,487,013	14,812,001	88·36
New Zealand .. .....	508,045	447,529	1,951,433	11·64
Australasia .....	.....	3,934,542	16,763,434	100·00

The number of men engaged in mining for gold is shown in the following table, and it would appear that the average value of gold won by each miner is £207 16s. 1d. per annum. It is probable that the number of gold miners in several of the states is largely overstated, otherwise the industry must be carried on at a great loss; and this will be the more apparent when it is remembered that a fairly large quantity of gold is obtained with other metals, the men employed in the exploitation of which are not classified as gold-miners. Moreover, many of the men employ themselves in mining for only a portion of their time, and devote the remainder to more remunerative pursuits. But when full allowance is made on this score, it will be evident that, in some of the states at least, the search for gold is not a profitable occupation. The small return for South Australia is due to the large number of Chinese engaged in the

industry, many of them not possessing proper appliances for working the claims.

State.	Miners Employed.	Average production of Gold.	
		Quantity.	Value.
	No.	oz. fine.	£ s. d.
New South Wales.....	10,610	15·19	64 11 2
Victoria .....	26,103	27·62	117 6 1
Queensland .....	9,045	70·81	300 15 9
South Australia.....	2,000	11·20	47 11 3
Western Australia .....	20,476	91·38	388 2 11
Tasmania.....	1,038	68·40	290 10 8
Commonwealth .....	60,272	50·34	213 16 6
New Zealand .....	11,398	39·26	171 4 2
Australasia .....	80,670	48·77	207 16 1

The most extensive development of quartz-reefing is found in Victoria, some of the mines being of a great depth. At the end of 1902 there were eight mines in the Bendigo district over 3,000 feet deep, and fourteen over 2,500 feet. In the Victoria mine a depth of 3,750 feet had been reached, and in the Lazarus Mine, 3,424 feet. On other fields there were six mines over 1,500 feet deep, the deepest of which were the South Star mine in the Ballarat district, where the shaft is down 2,520 feet, and the North Long Tunnel mine in the Walhalla district where a depth of 2,516 feet has been reached.

A notice of gold-mining would be incomplete without some reference to the remarkably large finds made at various times. Information on this point is meagre and not altogether reliable, as doubtless many nuggets were unearthed of which particulars were never published. Victoria's record is the best, and includes the following nuggets:—

	lb. oz. dwt.
"The Welcome Stranger," found 9th February, 1869.....	190 0 0
"The Welcome," found 9th June, 1858 .....	184 9 16
Nugget found at Canadian Gully, 31st January, 1853 .....	134 11 0

And others of the following weights:—98 lb. 1 oz. 17 dwt., 93 lb. 1 oz. 11 dwt., 84 lb. 3 oz. 15 dwt., 69 lb. 6 oz., 52 lb. 1 oz., 30 lb. 11 oz. 8 dwt., and 30 lb. 11 oz. 2 dwt.

New South Wales can boast of having produced some splendid specimens. In 1851 a mass of gold was found on the Turon, weighing 106 lb.; another, from Burrandong, near Orange, produced when melted at the Sydney Mint 98 lb 6 oz. 6 dwt. of pure gold; and a third, the "Brennan," was sold in Sydney in 1851 for £1,156. During 1880-82 several nuggets were discovered at Temora, weighing from 59 oz. to 1,393 oz.; and others, of 357 oz., 347 oz. (the "Jubilee"), 200 oz., 47 oz., and 32 oz. respectively, were found during the year 1887 in various parts of the State. Veins of gold of extraordinary richness have been worked in New South Wales. In January, 1873, at Beyers and Holterman's claim, at Hill End, 1·02 cwt. of gold was obtained from 10 tons of quartz, and a mass of ore, weighing 630 lb. and estimated to contain £2,000 worth of gold, was exhibited. The Mint returns for this mine during the year 1873 were 16,279·63 oz., valued at £63,234 12s., obtained from 415 tons of stone. From Krohman's claim, at Hill End; gold to the value of £93,616 11s. 9d. was obtained during the same year. The foregoing figures, however, are insignificant when compared with the enormous yield of the Mount Morgan Mine, in Queensland, which has paid over £5,750,000 in dividends. This mine, which may be designated one of the wonders of the world, is a huge mound of ore, highly ferruginous, the peculiar formation, in the opinion of the Government Geologist of Queensland, being due to the action of thermal springs. To the end of May, 1903, 2,624,319 oz. of gold had been won from 2,005,396 tons of ore, yielding an average of 1 oz. 6 dwt. 4 gr. per ton of ore treated.

For the ten years ended 1902, the world's production of gold is estimated to have been as follows:—

Year.	Value.	Year.	Value.
	£		£
1893	30,731,000	1898	58,137,000
1894	37,345,000	1899	63,057,000
1895	39,191,000	1900	51,578,000
1896	41,009,000	1901	52,738,000
1897	48,088,000	1902	60,197,000

Of the production of £60,197,000 in 1902, Australasia produced 27·85 per cent.

#### SILVER.

Silver has been discovered in all the states, either alone or in the form of sulphides, antimonial and arsenical ores, chloride, bromide

iodide, and chloro-bromide of silver, and argentiferous lead ores, the largest deposits of the metal being found in the last-mentioned form. The leading silver mines are in New South Wales, the returns from the other states being comparatively insignificant. Up to the year 1882 the quantity of silver raised in New South Wales was very small, but in that and the following years extensive discoveries of the metal, associated principally with lead and copper ore, were made in various parts of the State, notably at Boorook, in the New England district, and later on at Sunny Corner, near Bathurst, and at Silverton and Broken Hill on the Barrier Ranges in the Western district. The Sunny Corner Silver mines in 1886 paid handsome dividends, and produced £160,000 worth of silver, but since that period the yield has largely fallen off.

The fields of the Western district of New South Wales have proved to be of immense value. The yield of silver-lead ore in the Broken Hill and Silverton districts during 1902 was valued at £1,052,916; while the machinery employed was valued at £606,484. This is much less than the value set down some years ago, the reduction being chiefly due to the removal of machinery to Port Pirie, in South Australia, where the smelting operations of the Proprietary Company are now wholly carried on. The aggregate output of the mines in the Barrier country to the end of the year named was valued at £30,945,073. This rich silver-field, which was discovered in 1883 by Charles Rasp, a boundary rider on Mount Gipps Run, extends over 2,500 square miles of country, and has developed into one of the principal mining centres of the world. It is situated beyond the river Darling, and close to the boundary between New South Wales and South Australia. In the Barrier Range district the lodes occur in Silurian metamorphic micaceous schists, intruded by granite, porphyry, and diorite, and traversed by numerous quartz reefs, some of which are gold-bearing. The Broken Hill lode is the largest as yet discovered. It varies in width from 10 feet to 200 feet, and may be traced for several miles, the country having been taken up all along the line of the lode, and subdivided into numerous leases, held by mining companies and syndicates.

The Broken Hill Proprietary Company hold the premier position. They have at Port Pirie, in South Australia, a complete smelting plant on the latest and most approved principles. From the commencement of mining operations in 1885 to the end of May, 1903, the company treated 6,544,468 tons of silver and silver-lead ores, producing 119,564,327 oz. of silver and 598,835 tons of lead, valued in the London market at £25,688,000. Dividends and bonuses to the amount of £7,592,000 have been paid, besides the nominal value of shares from the several "Blocks." The sum spent in the erection and construction of plant, from the opening of the property, has been about £1,271,502. The mine wages and salary sheet for the twelve months represented a sum of £622,515, including £155,961 paid to contractors, and £10,933 for quarrying. The net profit for the year was £113,416.

The quantity and value of silver and silver-lead ore exported by New South Wales to the end of 1902 is shown in the following table :—

Year.	Silver.		Silver-Lead.			Total value.
	Quantity.	Value.	Quantity.		Value.	
			Ore.	Metal.		
Up to	oz.	£	tons cwt.	tons cwt.	£	£
1882	765,397	187,429	203 12	.....	5,385	192,814
1883	77,066	16,488	105 17	.....	1,625	18,113
1884	93,660	19,780	4,668 1	.....	123,174	142,954
1885	794,174	159,187	2,095 16	190 8	107,626	266,813
1886	1,015,434	197,544	4,802 2	.....	294,485	492,029
1887	177,308	32,458	12,529 3	.....	541,952	574,410
1888	375,064	66,668	11,739 7	18,102 5	1,075,737	1,142,405
1889	416,895	72,001	46,965 9	34,579 17	1,899,197	1,971,198
1890	496,552	95,410	89,719 15	41,319 18	2,667,144	2,762,554
1891	729,590	134,850	92,383 11	55,396 3	3,484,739	3,619,589
1892	350,661	56,884	87,504 15	45,850 4	2,420,952	2,477,836
1893	531,972	78,131	155,859 1	58,401 3	2,953,589	3,031,720
1894	846,822	94,150	137,813 8	42,513 2	2,195,339	2,289,489
1895	550,142	81,858	190,192 19	29,687 7	1,560,813	1,642,671
1896	292,789	26,518	267,363 1	19,573 4	1,758,933	1,785,451
1897	150,005	16,711	270,913 14	18,105 7	1,681,528	1,698,239
1898	533,059	59,278	388,460 4	10,108 13	1,644,777	1,704,055
1899	692,036	76,913	424,337 5	20,289 10	1,993,744	2,070,657
1900	774,203	90,243	420,909 11	17,928 6	2,513,874	2,604,117
1901	448,501	50,484	400,156 18	16,921 5	1,803,979	1,854,463
1902	1,067,224	105,360	365,646 1	15,412 18	1,334,819	1,440,179
Total	11,088,554	1,718,345	3,374,369 10	444,379 10	32,063,411	33,781,756

This amount was approximately made up of 154,696,388 oz. of silver, valued at £24,056,883; and of 772,198 tons of lead, valued at £9,724,873. It will be seen that the production of silver in New South Wales rapidly increased until 1891, when it exceeded in value the largest annual production of gold, even in the palmiest days of the diggings. Since that year, however, there has been a decreased output consequent upon the lower grade of the ores now being worked, while the value has been still further reduced by the serious decline in the prices of silver and lead. The price of silver has been declining steadily for some years, and in 1902 it fell below all previous records, while lead also depreciated in value. As many of the lower-grade mines at Broken Hill had only been worked at a profit on account of the high value of the lead contained in the ores, the heavy fall in the price of lead combined with a decline in the value of silver caused all but four of the principal Barrier mines temporarily to suspend the output of ore.

The serious effects of the decline may be judged from a comparison of the employment afforded by the industry during the last three

years. The number of miners engaged in silver and lead mines in 1900 was 8,196, and the average value of the metals won amounted to £317 14s. 7d.; in 1901 the number of men employed had fallen to 6,298, and the average value won to £294 9s. 1d.; while in 1902 the men engaged numbered only 5,382, and the average value won £267 11s. 6d.

There are two large smelting works in New South Wales, one of which is situated at Cockle Creek, near Newcastle, and the other at Dapto. These works have proved of great service to the mining communities, both in this and neighbouring States, as large supplies of ore are received for treatment from all parts of Australasia. The quantity of ore, the product of the state, treated during the year, was 53,508 tons, the metal obtained being as follows:—

Gold	...	...	...	...	21,427 oz.
Silver	...	...	...	...	1,537,656 oz.
Lead	...	...	...	...	23,849 tons.
Copper	...	...	...	...	179 tons.
Spelter	...	...	...	...	220 tons.

The number of men employed on these works at the end of 1902 was 745.

The only other state where silver has been produced to any extent is Tasmania. The industry has been steadily developed, and the production for the last few years shows a considerable advance on that in former years. The value of the output during each of the last five years was—

1898	.....	£270,893
1899	.....	377,788
1900	.....	252,080
1901	.....	207,228
1902	.....	218,864

In this state, as in New South Wales, the result of the fall in silver and lead values is seen in the diminished value of production, and in this connection it must be remembered that a decline in price not only decreases the value of the output, but checks production inasmuch as operations are restricted to dealing only with higher-grade ores. The principal silver fields are in the West Coast District, where the most important mines are the Zeehan-Montana, British Zeehan, and Mount Zeehan; and in the North-Western District where the Mount Magnet mine is located. The largest output of silver, however, is from the Mount Lyell mine, where the metal is found in conjunction with copper, and the output from this and the mines first mentioned, together with that from the Zeehan Queen and Hercules mines, comprises nearly the whole of the production. The latter mine, situated in the Mount Read district, has abundance of silver ore in sight, while copper is also found.

Silver is found in various districts in Queensland, but generally associated with some other mineral, and the mines where silver predominates are but few. The chief of these is the Silver Spur mine at

Texas, in the Stanthorpe district, on the border of New South Wales, from which 74,820 oz. of silver, valued at £7,482, were obtained during 1902. The year 1901 saw a distinct improvement in the production of silver, and this in the face of a great decline in the prices of silver and lead. This improvement was more than maintained during 1902, and the production for the year was 701,312 oz., valued at £70,145, being the highest total recorded since 1887, when the yield was valued at £80,092. The great advance made in copper-mining during recent years is responsible for the increased silver production, as these minerals are usually found in association. This may be seen from the fact that the Herberton district, which was the chief copper-producing centre in 1902, also contributed the greater portion of the silver produced.

In New Zealand, silver is found in various localities, principally on the Te Aroha, Thames, and Coromandel fields, but the metal is generally obtained in conjunction with gold. The production of the colony during the year 1902 was 674,196 oz., valued at £71,975.

There are no silver-mines in Victoria or Western Australia, the small amount of silver produced in those States being usually found associated with gold. During 1902 the value of the silver produced in Western Australia was only £9,467, and in Victoria £4,900. The production of silver in South Australia is not large, the value in 1902 being £19,740, and it would seem that the argentiferous lead-ore fields of Broken Hill and Silverton, which are almost on the border of the two States, are exclusively confined within the boundaries of New South Wales.

Up to the end of 1902 New South Wales had produced 87·3 per cent of the total value of silver raised in Australasia; Tasmania came second with 6·7 per cent; and of the remaining small proportion, Victoria claimed the largest share. The total production of silver in Australasia in 1902, and up to the end of that year, was as follows:—

State.	Value of Silver produced—	
	During 1902.	To end of 1902.
	£	£
New South Wales .....	1,440,179	33,781,756
Victoria .....	4,900	861,439
Queensland .....	70,145	853,187
South Australia .....	19,740	133,370
Western Australia .....	9,467	21,072
Tasmania .....	218,864	2,603,750
Commonwealth .....	1,763,295	38,264,574
New Zealand .....	71,975	452,781
Australasia .....	1,835,270	38,717,355



The world's production of silver during the ten years ended 1902 is estimated to have been as follows :—

Year.	Ounces.	Year.	Ounces.
1893	162,162,000	1898	179,252,000
1894	178,668,000	1899	177,837,000
1895	182,220,000	1900	180,093,000
1896	176,707,000	1901	174,851,000
1897	182,081,000	1902	175,691,000

The output of New South Wales during 1902 therefore represented about 7·5 per cent. of the total production of silver.

#### COPPER.

Copper is known to exist in all the States, and has been mined for extensively in South Australia, Tasmania, New South Wales, and Queensland. The fluctuations in the market value of the metal have always been a check to the progress of the industry, and at various periods in the last two years some of the lower-grade mines have been compelled to suspend operations. South Australia has produced the greatest quantity of copper, but of late years Tasmania has had by far the largest output. In Tasmania deposits were worked on a limited scale for a number of years ; but the discovery of a rich belt of copper-bearing country, extending from Mount Lyell past Mount Tyndall, Mount Read, Mount Murchison, and north of the Pieman to the Rocky and Savage Rivers, has completely changed the character of the mining industry in the State, and from a small export of copper ore valued at £1,659 in 1896, the annual production has become the largest in Australasia. The following table, which shows the annual production of copper during the last five years, will give some idea of the development of this branch of the mining industry. The output would appear to have fallen considerably in 1902, but this is due to the fact that in previous years the gold contents of the ore have been included in the values given.

	£
1898.....	408,796
1899.....	762,138
1900.....	970,877
1901.....	1,010,037
1902.....	577,533

The chief mines belong to the Mount Lyell Mining and Railway Company which is reported to have spent over £400,000 on railway

construction and developmental work at the mines before receiving any return. The company possesses reduction works at Queenstown, from which a railway has been constructed through most difficult country to Teepookana and thence to Strahan. The output from these mines during the year ended 30th June, 1903, averaged 1,000 tons of ore daily, and the contents were 6,141 tons of copper, 604,860 oz. of silver, and 22,278 oz. of gold, the total value thereof being £513,351.

The discovery of copper had a marked effect upon the fortunes of South Australia at a time when the young and struggling colony was surrounded by difficulties. The first important mine, the Kapunda, was opened up in 1842. It is estimated that at one time 2,000 tons were produced annually, but the mine was closed in 1879. In 1845 the celebrated Burra Burra mine was discovered. This mine proved to be very rich, and paid £800,000 in dividends to the original owners. For many years the average yield was from 10,000 to 13,000 tons of ore, yielding from 22 to 23 per cent. of copper. For the period of thirty years during which the mine was worked the output of ore amounted to 234,648 tons, equal to 51,622 tons of copper, valued at £4,749,224. Boring operations were conducted at the mine for the purpose of determining whether payable ore exists at greater depths than those reached by the original workings. One bore was put down to a depth of 1,004 feet, and in the the opinion of the Government Geologist, the result was highly satisfactory, as it proved the continuance downwards of the copper-bearing strata sufficiently to warrant the reopening of a portion of the mine. The Wallaroo and Moonta mines, discovered in 1860 and 1861, proved to be even more valuable than the Burra Burra. The Moonta mine employed at one time upwards of 1,600 hands, and still keeps 1,138 men at work. In 1890 these mines were amalgamated, and the estimated value of the copper produced to the end of 1898 is set down at £9,218,482, out of which about £7,000,000 had been expended in wages. About 1,800 miners are now employed. The total dividends paid by these mines were stated to be upwards of £1,700,000. The production of copper in South Australia during the last few years has again increased, the output in 1901 being valued at £500,077, and in 1902 at £432,525.

The copper-mining industry in New South Wales has been subject to great variations. The production reached its highest point in 1883, when the value was £472,982. From that year, however, there was a general decline, and in 1894 the value was only £63,617. As in the other States, so in New South Wales, the increased prices of later years caused more attention to be directed to the industry, and the production in 1901 had attained a value of £412,292. A heavy fall in prices occurred during that year, however, which, combined with the drought, caused a considerable falling off in production and value. The value of the output in 1902

was only £307,806, a decrease of £104,486 on that of the preceding year. The chief copper-mines are in the western districts, and lack of water led to the closing of several of the most important during portion of the year. At the Great Cobar Mine the company was enabled to carry on operations through the Government arranging to despatch a supply by water train during the dry period. In other districts those mines which were working on low-grade ores were compelled to suspend operations, as at the prevailing prices the ore would not realise a profit on the cost of raising and carriage to the smelting works at Cockle Creek or Dapto. The principal deposits are found in the central part of the state, between the Macquarie, Bogan, and Darling Rivers. Cupriferous strata have also been located in the New England and Southern districts, as well as at Broken Hill, thus showing that the mineral is widely distributed. The largest proportion of the copper produced during 1902 was obtained in the Cobar mining district. The value of the metal raised in the Cobar division of the district amounted to £130,802. It is in this district that the Great Cobar, the largest copper-mine in New South Wales, is situated. The Nymagee division of the Cobar district produced copper to the value of £133,350. In the Burruga division of the Bathurst district one of the leading mines, the Lloyd Copper mine, is situated, and from this mine which was only worked during the first eight months of 1902, owing to the failure of the water supply, 29,440 tons of ore, valued at £66,200, were raised. The lode, which averages 5 feet in width, still maintains its richness, and there are sufficient supplies in sight to last some years. The company employs about 500 men in the mine and works, which are lighted throughout by electricity. The Crawl Creek mine, at Shuttleton, which was opened in 1901 has been further developed with satisfactory results. The total number of men engaged in copper-mining during 1902 was 1,699, a decrease of 1,265 on the numbers of the preceding year.

Copper is found in many parts of Queensland, the principal deposits being in the Herberton and Mount Perry districts. In earlier years the state occupied a prominent position as a producer of copper, but the output in recent years was very small. The year 1901, however, saw a sudden revival in this branch of the mining industry, despite a great fall in prices, and the value of the production rose to £194,227, being the highest value recorded with the exception of 1872, when it reached £196,000. This figure, however, was not maintained in 1902, the production for that year amounting to 3,784 tons, valued at £189,200. A noteworthy feature of the revival was the re-opening of the Mount Perry mine, which afforded employment for over 300 men in 1902, and promises to rank, as in former years, amongst the foremost mines in the State. The Herberton district has for many years been the chief copper-producing centre, the output in 1902 being valued at £122,950. Of the copper-mines in this district, and in the State as a whole, the foremost is Mount Garnet, which produced copper and silver to the

value of £164,267 during 1902. The mine is well equipped with machinery, and a railway has been constructed to connect with the Chillagoe line. On the 31st March, 1902, the New Chillagoe Railway and Mines which had been closed since December, 1901, were re-opened, and systematic prospecting is being carried on in the mines with favourable results. One of the chief obstacles to the successful development of copper and silver-mining has been the lack of facilities for transport, but with the increased advantages in this respect which are being afforded year by year, the output of copper and silver may be expected to increase materially.

In Western Australia, copper deposits have been worked for some years. Very rich lodes of the metal have been found in the Mount Malcolm, Northampton, Murchison, West Pilbarra, and Phillips River districts, but operations appear to be carried on systematically only in the first mentioned. The ore raised in this district is treated locally, while in the others it is exported for treatment, and, as the cost of carriage is heavy and the facilities for transport unfavourable, only high-grade ores can be profitably worked. The copper ore raised in the State during 1901 amounted to 10,156 tons, valued at £75,246, but in 1902 only 2,262 tons, with a value of £8,090 were produced. The unfortunate fall in the price of the metal has restricted operations, but as there seems no doubt that eminently payable copper lodes, carrying a little gold, exist in the state, it is surprising that the success of the preceding three years has not further stimulated the progress of the industry. The number of men engaged in copper-mining in 1902 was only 113, as against 321 in the preceding year.

Copper-mining has not attained any great proportions in Victoria, although deposits have been found in several parts of the State, particularly in the Beechworth district, where they have been traced over an area of some 50 square miles. The value of the total production is estimated at £206,395, but there has not been any output during the last few years.

The copper deposits of New Zealand have been worked to a small extent only, and for a number of years have been almost entirely neglected, the output in 1901 being valued at only £105, while in 1902 there was no production.

Copper is sometimes found in the Australasian mines in a virgin state, and beautiful specimens of the pure metal have been exhibited at different times, but it occurs generally in the form of oxidised copper ores, carbonates, sulphates, phosphates, and silicates of copper. The museums of South Australia, Victoria, and New South Wales contain striking samples of azurite and malachite, magnificent blocks of which have been shown from time to time at exhibitions, not only in Australasia, but also in Europe and America. Copper sulphides and arsenides are generally found in deep sinkings. The metal has also been found associated with tin in the form of stannine.

The total value of copper produced in each State during 1902 and up to the end of that year are given below :—

State.	Value of Copper produced.	
	During 1902.	To end of year 1902.
	£	£
New South Wales .....	307,806	6,164,879
Victoria .....	.....	206,395
Queensland .....	189,200	2,438,892
South Australia .....	432,525	23,254,571
Western Australia .....	8,090	335,062
Tasmania .....	577,533	4,499,028
Commonwealth .....	1,515,154	36,898,827
New Zealand .....	.....	18,088
Australasia .....	1,515,154	36,916,915

In June, 1872, copper realised as much as £112 per ton, whilst in December, 1886, the lowest price on record until that time was touched, and only £44 could be obtained for South Australian copper. At the end of 1887 the price had risen to £70 per ton, and in September, 1888, to £93. In March, 1889, there was a great fall in the price of the metal, and in April of that year the quotation in London was as low as £43 per ton. This was the lowest price reached until June, 1894, when it fell to £41 10s. From that date there was an upward movement, as the following quotations will show. At the close of 1896 the London price of copper stood at £52 10s. per ton; in February, 1897, £54 10s. was reached; and at the 31st December, 1898, £60 was the market value. This price was further increased during 1899, and in September of that year no less than £77 per ton was quoted. The price was well maintained during 1900, and, at the close of the year, stood at £73 per ton; but in 1901 a heavy fall occurred, and the quotations for the last week of the year were as low as £49 15s. per ton. During 1902 prices remained low, but gradually improved towards the end of the year. In the first week of January, 1903, the value was £53 12s. 6d. per ton.

#### TIN.

Tin was known to exist in Australasia almost from the first years of colonisation, the earliest mention of the metal appearing in a report of a discovery by Surgeon Bass on the north coast of Tasmania. In the form of cassiterite (oxide of tin) it occurs in all the states, but the richest deposits have been found in Tasmania—the Mount Bischoff being the most celebrated tin-mine in Australasia. Expert authorities have also stated that Queensland and the Northern Territory of South Australia possess rich deposits of tin ore.

Tasmania has been the largest producer of tin in Australasia. As in New South Wales, a very large proportion of the metal hitherto produced has been from alluvial deposits, and the want of water has proved a great drawback to the successful development of the industry. There are, however, many promising lodes in the island, and the Waratah, Blue Tier, Ben Lomond, St. Helen's, Derby, and West Coast districts all produce large quantities of the metal. In the district first mentioned is situated the Mount Bischoff mine, worked as an open quarry, which, during the year ended 30th June, 1903, produced 1,276 tons of tin, and paid £54,000 in dividends. In the Blue Tier district, the Australian and Anchor mines are working on good payable stone, and from the latter mine 250 tons of tin, valued at £19,686, were obtained during the year ended 30th June, 1903. Of the mines in the North-Eastern District, the most important are the Briseis, at Derby, and the Pioneer, at Bradshaw's Creek. The former gave employment to 111 men during the year ended 30th June, 1903, and produced 387 tons of tin, while the latter yielded 692 tons of stream tin, and paid dividends amounting to £16,875. Tin-dredging has been carried on in some parts of the island; but, so far, only a moderate measure of success has been achieved. The production of tin during 1902 was valued at £242,990, the value for 1901 being £216,186.

In New South Wales lode tin occurs principally in the granite and stream tin under the basaltic country in the extreme northern portion of the State, at Tenterfield, Emmaville, Tingha, and in other districts of New England. The metal has also been discovered in the Barrier Ranges, at Poolamacca and Euriovie; near Bombala in the Monaro district; at Gundle, near Kempsey; at Jingellic, on the Upper Murray; at Dora Dora, on the Upper Murray; and in the Valley of the Lachlan; but in none of these districts has it been worked to any extent. The mineral was discovered by the Rev. W. B. Clarke so far back as the year 1853, but the opening of the tin-fields of New South Wales only took place in the year 1872. The industry soon attained considerable importance, the value of the output in 1881 amounting to £568,795. In 1889 the total production had fallen to £207,670, and in 1893 to £126,114, while in 1898 the lowest point was reached, when the value was only £45,638. Owing to a recovery in prices there was an increase in value of production during the next two years when the totals were £90,482 and £142,724 respectively, but in 1901 there was a decline to £76,544, and in 1902 to £59,593. The fluctuations in the market price of the metal have always had a discouraging effect on the industry and the heavy fall which occurred during 1901 no doubt tended to diminish the production of that and the following year. In addition to the fall in prices, the industry has had to contend with a long-sustained drought, and as a large proportion of the tin obtained is recovered from alluvial deposits, any scarcity of water diminishes the production by retarding successful washing operations. Lack of sufficient water during the year 1902 was responsible for the closing of the Leviathan mine near Inverell, which

was opened in 1901, and gave promise of very favourable results. What appeared to be an extension of the Leviathan lode was discovered at a place about 5 miles distant, where the Dolcoath Syndicate opened a mine, but so far with negative results. Success has attended the attempts to recover tin by dredging, good returns being obtained in 1902 by dredges operating at Cope's Creek in the Tingha district. The total quantity of tin won by dredging in 1902 amounted to 110 tons, valued at £8,300. The number of persons engaged in tin-mining during 1902 was 1,288, of whom 302 were Chinese.

In Queensland, the value of tin produced during 1873 reached £606,184, being next in importance to that of gold, but thenceforward there was a decline, the yield in 1898 falling to £36,502. Since that year, however, there has been a considerable improvement, and some attempt has been made to develop the industry in a manner more worthy of its resources, the returns for 1901 and 1902 being £93,723 and £116,171 respectively. The Herberton district was again the chief centre of production, the output in 1902 being valued at £84,297. The most important mines in this district are situated at Irvinebank, and from one of them, the Vulcan, 5,468 tons of black tin, valued at £181,000, have been obtained since October, 1890. The output of the mine for 1902 was 528 tons, valued at £24,784. In 1901 a rich discovery of tin was made at Smith's Creek, near the Mount Garnet railway, and shafts sunk to a depth of 300 feet have proved the lode to be continuous. The number of persons engaged in tin-mining on the 31st December, 1902, was 1,467.

In Western Australia, tin has been found to exist in large quantities, but the ore is of inferior quality, and, until recent years the industry languished owing to the superior attractions of the goldfields, the average annual production for the three years ending with 1898 being only £3,960. The advance in price gave a stimulus to the industry in the following year, and the output increased considerably, being valued at £25,270. In 1900 the yield amounted to £56,702, but declined during the next year to £40,000, while in 1902 only 620 tons, valued at £39,783, were produced. Of the total output in 1902 the Greenbushes district contributed 403 tons, valued at £24,680, and the Pilbarra field, in the Marble Bar district, 217 tons, valued at £15,103. The full development of the industry in both districts is retarded by the inadequacy of the water supply.

The yield of tin in Victoria is small, no discoveries of any importance having been recorded prior to 1890, but towards the end of that year extensive deposits were reported to exist in the Gippsland district at Omeo and Tarwin. In 1902 the production was only 10 tons, valued at £500, this small return being obtained in connection with gold-dredging.

In South Australia very little tin is produced. During 1902 the production was 126 tons of ore, valued at £6,078, of which the Northern Territory was responsible for 119 tons, valued at £5,985. There is no record of any production of tin in New Zealand.

The tin-mining industry has been subject to frequent fluctuations, especially of late years. The value of the metal in the European market was £159 per ton in 1872, £52 in 1878, £114 in 1880 and 1882, and £72 in 1884. A gradual recovery then took place, until in 1888 the price reached £121. During the ten years from 1888 to 1898 tin was subject to an almost continuous fall in price, realising in 1898 only one-half of that obtained a decade before. The metal, however, made a great advance in price during 1900, London quotations in December being £125 10s. per ton, as compared with £82 in 1898, and £63 in 1897, and although this value was not maintained during 1901, the prices current at the end of the year averaged £109 10s. per ton. In 1902 there was a further improvement, and for the first week of 1903 the quotations were £123 10s. per ton.

The value of the production of tin in Australasia during 1902, and up to the end of that year, was as given below :—

State.	Value of Tin produced.	
	During 1902.	To end of year 1902.
	£	£
New South Wales .....	59,593	6,661,399
Victoria .....	500	715,998
Queensland .....	116,171	4,810,037
South Australia .....	6,078	38,758
Western Australia .....	39,783	237,982
Tasmania .....	242,990	7,519,234
Australasia .....	465,115	19,983,458

The number of persons engaged in tin-mining in 1902 was as follows :—In New South Wales, 1,288 ; Tasmania, 1,254 ; Queensland, 1,467 ; and Western Australia, 249.

#### IRON.

Iron is distributed throughout Australasia, but for want of capital in developing the fields this industry has not progressed. In New South Wales extensive deposits of iron ore exist in the Mittagong, Piper's Flat, Goulburn, Queanbeyan, and Port Stephens districts.

At Carcoar and Cadia there are large deposits of rich ore, the quantities in sight being estimated by the Government Geological surveyor at 3,100,000 and 39,000,000 tons respectively. The pig iron produced from the Carcoar ore would be admirably adapted for foundry purposes, and is suitable for use in the basic process of steel manufacture, while the ore at Cadia contains little phosphorus and could be utilised in the manufacture of steel by the cheaper acid processes. Considerable attention has been given to the question of establishing ironworks in



this state, capable of supplying the requirements of Australia, and in 1901 the idea assumed a definite shape. Two schemes were advocated—one to smelt ore at Lithgow from the Carcoar and Cadia deposits, and the other to bring ore from the Blythe River, Tasmania, and smelt it in Sydney or elsewhere on the seaboard. Had the Bonus for Manufactures Bill, introduced into the Federal Parliament, been passed in the same form as submitted, there is no doubt that the first of these schemes would have been adopted and the industry established immediately by private enterprise. The amendments made in the Bill, however, provide only for a bonus to works established by a State of the Commonwealth, and in view of the importance of the question, the Federal Government appointed a Royal Commission to inquire into the whole matter, and this Commission by a majority reported in favour of granting a bonus on the manufacture of iron and steel from Australian ores.

The principal works in New South Wales for the manufacture of iron from the ore are situated at Eskbank, near Lithgow, where red siliceous ores, averaging 22 per cent., and brown hematite, yielding 50 per cent., metallic iron, have been successfully treated. Abundance of coal and limestone are found in the neighbourhood. The manufacture of pig-iron, for which the establishment was originally built, has been abandoned for some years, and the work now carried on consists of the re-rolling of old rails, and the manufacture of iron bars, rods, and nails, and of ordinary castings. The quantity manufactured from scrap during 1902 was 6003 tons, valued at £82,273. During the past four years considerable quantities of iron ore have been raised from the deposits situated in the Marulan, Picton, and Carcoar districts and despatched to the smelting-works at Dapto and Cockle Creek, where they have been used as flux, the gold contents of the ore helping to defray the extra cost of railway carriage. The total raised in 1902 was 13,555 tons, valued at £10,690, and up to the end of that year 41,358 tons, valued at £33,588, had been raised. A considerable quantity of iron oxide is also raised each year and used for flux, while there is also a slight export, the amount, in 1902, being 188 tons, valued at £395.

In Tasmania a huge deposit of iron ore has long been known to exist at the Blythe River, near Burnie. During 1901 the deposit was tested by tunnelling and found to maintain its size and quality, and although arrangements for its exploitation are not yet completed, there is little doubt that in the near future it will prove an important addition to the industrial wealth of the State. Up to the present the production of iron ore has not been great, but in 1902 2,386 tons, valued at £1,075 were raised.

In Queensland deposits of iron ore have been found at Stanthorpe, and 430 tons, valued at £215, were raised in 1901, but there has since been no further production.

Magnetite occurs in great abundance in Western Australia, together with hematite, and the ores would prove of enormous value if a

sufficiency of cheap labour were available. A considerable quantity of ironstone is raised in the state and used for fluxing purposes, the production in 1901 being 20,569 tons, valued at £13,246. Owing to the closing down of the smelting works at Fremantle the quantity raised in 1902 was only 4,800 tons, valued at £2,040.

In New Zealand 17 tons of hematite, valued at £116, were raised in 1902.

Goethite, limonite, and hematite are found in New South Wales, at the junction of the Hawkesbury sandstone formation and the Wianamatta shale near Nattai, and are enhanced in value by their proximity to coal-beds. Near Lithgow extensive deposits of limonite or clay-band ore are interbedded with coal. Siderite or spathic iron (carbonate of iron) and vivianite (phosphate of iron) are found in New Zealand. The latter also occurs in New South Wales, intermingled with copper and tin ores.

The Government of South Australia has offered a bonus of £2,000 for the first 500 tons of pig-iron produced in that State.

#### ANTIMONY.

Antimony is widely diffused throughout Australasia, and is sometimes found associated with gold. The low price of the metal during late years has discouraged operations in this branch of the mining industry, and the output in all the States has fallen away considerably. In New South Wales, deposits of antimony occur in various places, chiefly in the Armidale, Bathurst, and Rylstone districts; and at Bowraville on the North Coast. The production, however, is confined to the Hillgrove mines, and in 1902 was valued at only £542, the total production to the end of the year being £194,775.

In Victoria the production up to the end of 1898 was valued at £177,174, but there has been no further output since that year, while in Queensland the production ceased in 1899, when the value raised was only £200. In New Zealand also, the production of antimony has practically ceased, although during 1901 there was an export of 3 tons, valued at £101. Good lodes of stibnite (sulphide of antimony) have been found near Roebourne, in Western Australia; but no attempt has yet been made to work them.

The following table shows the value of antimony produced in Australasia up to the end of 1902 :—

State.	Value.
New South Wales .....	£194,775
Victoria .....	177,174
Queensland .....	35,458
Commonwealth .....	£407,407
New Zealand .....	52,462
Australasia .....	£459,869

## BISMUTH.

Bismuth is known to exist in all the Australian states, but up to the present time it has been mined for in New South Wales, Queensland, South Australia, and Tasmania only. The demand for the metal is limited, and mining is hardly remunerative at present prices. The output in New South Wales during 1902 was valued at £3,100, and in Queensland £123, while the total production for each state up to the end of the year was £66,285 and £64,535 respectively.

## MANGANESE.

Manganese probably exists in all the states, although no deposits have as yet been found in Tasmania. Little, however, has been done to utilise the deposits, the demands of the local markets being extremely limited; but in the event of the extensive iron ores of New South Wales being worked on a large scale, the manganese deposits in that State will become of commercial importance. The ore generally occurs in the form of oxides, manganite, and pyrolusite, and contains a high percentage of sesquioxide of manganese. The production has never attained much importance in any of the States. The value of the output in New South Wales during 1901 was £24, making a total of £1,401 up to the end of that year. There is no record of production in 1902.

In Queensland the output for 1902, valued at £3,000, was obtained solely from the Mount Miller mine, the entire yield being absorbed by the works of the Mount Morgan mines. The total value of the production of this metal in Queensland to the end of 1902 was £24,980.

In New Zealand the value during 1900 was £588, and the total raised to the end of that year £60,232, but there has since been no further production. In South Australia there was an export during 1902 of 18 tons, valued at £62.

## PLATINUM.

Platinum and the allied compound metal iridosmine have been found in New South Wales, but so far in inconsiderable quantities, the latter occurring commonly with gold or tin in alluvial drifts. At present mining operations are confined to the deposits in the Fifield district, which, however, give evidence of depletion. A lease of 130 acres has been taken up at Macauley's Lead, about 20 miles from Woodburn, while the old claims at Little Darling Springs and Mulga Springs, in the Broken Hill district, are again to be thoroughly prospected. The value of the production during 1902 was £750, and the total to the end of that year, £13,961. Platinum and iridosmine have also been found in New Zealand.

## TELLURIUM.

The noble metal tellurium has been found in New Zealand, associated with gold and silver (petzite) and with silver only (hessite). It has also been discovered in New South Wales at Bingara and other parts of the northern districts, as well as at Tarana, on the Western Line, though at present only in such minute quantities as would not repay the cost of working; while at Captain's Flat it has been found in association with bismuth.

At many of the mines at Kalgoorlie, Western Australia, large quantities of ores of telluride of gold have been discovered in the lode formations.

## LEAD.

Lead is found in each of the Australasian States, but is worked only when associated with silver. In Western Australia the metal occurs in the form of sulphides and carbonates of great richness, but the quantity of silver mixed with it is small, and the production of late years has been very limited. In 1902 it amounted to 36 tons, valued at £277.

In Queensland the lead raised during 1902 amounted to 267 tons, valued at £2,706, and from South Australia lead to the value of £22,303 was exported during the year. As will be gathered from the remarks made in a previous portion of this chapter, the association of lead with silver has proved a source of much wealth to the silver mines in New South Wales—those at Broken Hill particularly—several of these mines being only enabled to continue operations owing to the high price of the lead contained in the ore.

## OTHER METALS.

Mercury, in the form of sulphides or cinnabar, is found in New South Wales, Queensland, and New Zealand. In New South Wales cinnabar has been discovered on the Cudgegong River, near Rylstone, and it also occurs at Bingara, Solferino, Yulgilbar, and Cooma. In the latter place the assays of ore yielded 22 per cent. of mercury. Very large and rich deposits have been found on Noggriga Creek, near Yulgilbar.

A series of experiments conducted with small parcels of the ore gave satisfactory results, and 1 ton of ore yielded 2 per cent. of mercury. A furnace, capable of treating between 40 and 50 tons per week, is being erected, and some 400 tons of ore have been raised and are awaiting treatment.

Titanium, of the varieties known as octahedrite and brookite, is found in alluvial deposits in New South Wales, in conjunction with diamonds.

Wolfram (tungstate of iron and manganese) occurs in most of the States, notably in New South Wales, Tasmania, Queensland, and

New Zealand. For some years there has been a small output in Queensland, and a rise in the price of the mineral so stimulated the industry that in 1899 the production reached £10,060. As the demand is limited, the increased price soon led to overproduction and a consequent fall in prices, and at present they are not sufficiently remunerative to encourage search for this mineral. The value of the production in 1902 was only £1,167. There was a little wolfram exported from South Australia during 1901, the quantity being 5 tons, valued at £175. In 1900 Tasmania produced a small quantity of the metal, valued at £2,058. Scheelite, another variety of tungsten, is found in Queensland and New Zealand, a little mining being carried on in the latter colony, where 39 tons, valued at £1,200, were raised in 1902. Molybdenum, in the form of molybdenite (sulphide of molybdenum), is found in New South Wales, Victoria, and Queensland, but only in the last-mentioned State was there any production during 1902, the value being £5,502.

Zinc ores, in the several varieties of carbonates, silicates, oxide, sulphide, and sulphate of zinc, have been found in several of the Australasian States, but have attracted little attention, except in New South Wales, where the metal is usually found associated with silver, lead, and copper; and various experiments are being made for the purpose of ascertaining whether it can be profitably extracted. For some years attention has been directed by the Broken Hill Companies to the production of a high grade zinc concentrate from the sulphide ores, and a fair measure of success has attended their efforts. The Sulphide Corporation has a magnetic separating plant in operation at Cockle Creek, and is producing high-grade zinc concentrates from the old dump of middlings, while the Australian Metal Company has found the magnetic separator, invented by their engineer, to work so satisfactorily that they have arranged to have a number of the machines in operation during 1903. The Broken Hill Proprietary are reported to hold possession of a process which will revolutionise the treatment of zinc-containing ores. The experiments made so far have proved satisfactory, but it remains to be seen whether the process can be worked successfully on a commercial scale. The value of zinc produced and exported reached a total of £49,207 in 1899, and £44,187 in 1900; but in 1901 there was a decline to £4,057. The value in 1902 was £10,625, and up to the end of that year £171,748. It is estimated that Europe alone requires 160,000 tons of spelter annually for the manufacture of roofing iron, and the heavy imports of the article into the Australian States show that there is a wide field here for the development of the industry.

Nickel, so abundant in the island of New Caledonia, has up to the present been found only in Queensland and Tasmania; but few attempts have been made to prospect systematically for this valuable mineral. In 1894 Tasmania produced 136 tons of nickel ore, valued at £544; but none has been raised since that date.

Cobalt occurs in New South Wales and Victoria, and efforts have been made in the former State to treat the ore, the metal having a high commercial value; but the market is small, and no attempt has yet been made to produce it on any large scale. The manganese ores of the Bathurst district of New South Wales often contain a small percentage of cobalt—sufficient, indeed, to warrant further attempts towards its extraction. The only deposits being worked at the present time are at Port Macquarie, where very promising ore has been opened up. During 1902, 34 tons, valued at £304, were exported.

Chrome iron or chrome ore has been found in New Zealand and Tasmania. In New South Wales chromium is found in the northern portion of the State in the Clarence and Tamworth districts, and also near Gundagai, usually in association with serpentine. Mining operations in New South Wales have been confined to the deposits at Gobarralong, near Gundagai, as it is uncertain whether those at Bowling Alley Point could be profitably worked. The accessible deposits at these mines are now almost worked out, and the production has consequently slackened. In 1899 the export was valued at £17,416, but in 1902 it had declined to £1,740. In New Zealand chrome ore to the value of £37,367 was extracted between 1858 and 1866, but there was no further production until the year 1900, when the value amounted to only £110. In 1902 there was also a small output, amounting to 175 tons, valued at £525.

Sulphur exists in large quantities in the volcanic regions of New Zealand, where it will doubtless some day become an important article of commerce. The output in 1900 was 1,692 tons, valued at £4,824, but in 1902 only 100 tons, valued at £475, were raised. It is also said to occur in small quantities at Mount Wingen, in the Upper Hunter district of New South Wales; at Tarcutta, near Wagga Wagga; and at Louisa Creek, near Mudgee.

Arsenic, in its well-known and beautiful forms, orpiment and realgar, is found in New South Wales and Victoria. It usually occurs in association with other minerals, in veins.

### COAL.

Australasia has been bountifully supplied by Nature with mineral fuel. Five distinct varieties of black coal, of well characterised types, may be distinguished, and these, with the two extremes of brown coal or lignite, and anthracite, form a perfectly continuous series. For statistical purposes, however, they are all included under the generic name of "coal," and therefore these minerals will be considered here only under the three main heads—lignite, coal, and anthracite.

Brown coal or lignite occurs principally in New Zealand and Victoria. Attempts have frequently been made to employ the mineral for ordinary fuel purposes, but its inferior quality has prevented its general use. In

Victoria there is usually a small annual output, the quantity raised in 1901 amounting to 150 tons, but there was no production in 1902. The fields of lignite in New Zealand are roughly estimated to contain about 500 million tons; the quantity raised annually is increasing, and in 1902 it amounted to 65,239 tons.

Black coal forms one of the principal mineral resources of New South Wales; and in the other states and New Zealand the rich deposits of this valuable substance are rapidly being developed. That they form an important source of commercial prosperity cannot be doubted, as the known areas of the coal-fields of this class in New South Wales have been roughly estimated to contain about 79,198 million tons, and in New Zealand 500 million tons. New Zealand also possesses a superior quality of bituminous coal, which is found on the west coast of the Middle Island. An estimate of the probable contents of these coal-fields is given as 200 million tons. Coal of a very fair description was discovered in the basin of the Irwin River, in Western Australia, as far back as the year 1846. It has been ascertained from recent explorations that the area of carboniferous formation in that state extends from the Irwin northwards to the Gascoyne River, about 300 miles distant, and probably all the way to the Kimberley district. The most important discovery of coal in the state so far is that made in the bed of the Collie River, near Bunbury, to the south of Perth. The coal has been tested and found to be of good quality; and there are grounds for supposing that there are 250 million tons on this field. Mr. Jack, formerly Government Geologist of Queensland, gave it as his opinion that the extent of the coal-fields of that state is practically unlimited, and that the carboniferous formations extend to a considerable distance under the Great Western Plains. It is roughly estimated that the coal measures at present practically explored extend over an area of about 24,000 square miles. In Tasmania and Victoria large deposits of coal have also been found; and in all the states the industry is being prosecuted with vigour.

Coal was first discovered in New South Wales in the year 1797, near Mount Keira, by a man named Clark, the supercargo of a vessel called the Sydney Cove which had been wrecked in Bass Straits. Later in the same year Lieutenant Shortland discovered the river Hunter, with the coal-beds situated at its mouth. Little or no use, however, was made of the discovery, and in 1826 the Australian Agricultural Company obtained a grant of 1,000,000 acres of land, together with the sole right, conferred upon them by charter, of working the coal-seams that were known to exist in the Hunter River district. Although the company held this valuable privilege for twenty years, very little enterprise was exhibited by them in the direction of winning coal, and it was not until the year 1847, when their monopoly ceased and public competition stepped in, that the coal-mining industry began to show signs of progress and prosperity. From the 40,732 tons extracted in 1847, the quantity raised had in 1901 expanded to the large figure

of 5,968,426 tons, valued at £2,178,929, both the output and value in the latter year being the highest recorded to that date. The production in 1902 was 5,942,011 tons, valued at £2,206,598, and the total quantity of coal extracted from the New South Wales mines, from the date of their opening up to the end of that year, amounted to 103,387,070 tons, valued at £41,701,442.

The coal-fields of New South Wales are classed in three districts—the Northern, Southern, and Western districts, but it is thought that coal deposits extend over nearly the whole length of the sea-coast. The first of these comprises chiefly the mines of the Hunter River district; the second includes the Illawarra district and, generally, the coastal regions to the south of Sydney, together with Berrima, on the table-land; and the third consists of the mountainous regions on the Great Western Railway, and extends as far as Dubbo. The total area of the carboniferous strata of New South Wales is estimated at 23,950 square miles. The seams vary in thickness. One of the richest has been found at Greta, in the Hunter River district; it contains an average thickness of 41 feet of clean coal, and the quantity underlying each acre of ground has been computed to be 63,700 tons.

It has long been known that a seam of coal existed under Sydney Harbour, and in 1899 a syndicate was formed to determine at what depth the deposit was situated. After boring operations had been carried on to a depth of 2,917 feet, a seam of coal 10 feet 3 inches—supposed to be identical with that at Bulli—was struck, and the syndicate now known as the Sydney Harbour Collieries (Limited) acquired mining rights extending over 10,167 acres. Some difficulty occurred in the selection of a site, but it was at length determined to sink the mine at Balmain, and a small seam of coal was found at a depth of 2,880 feet, while two other seams were struck at depths of 2,933 feet and 2,950 feet. It is fully expected that these seams will be found to unite at a distance of about 300 yards from the shaft, and should this prove to be the case, the effect on the industrial progress of Sydney will be of the utmost importance. At present the output from the mine is limited, but the coal is of good quality, and its capabilities for steaming purposes have been very favourably spoken of.

The number of coal-mines under inspection in New South Wales at the end of the year 1902 was 97 as compared with 96 in the previous year. They gave employment to 12,815 persons, of whom 10,050 were employed under ground, and 2,765 above ground. The average quantity of coal extracted per miner was 591 tons, as against an average of 619 tons in the previous year, and 612 tons in 1900. For the ten years ended 1902, the average quantity of coal extracted per miner was 546 tons, which, at the mean price of coal at the pit's mouth, was equivalent to £172 10s. 7d. Taking all persons employed at the mines, both above and under ground, the average for the ten years would be 440 tons, equivalent to £138 15s. 8d. per man. This production is certainly large, and compares favourably with the results exhibited by the principal



coal-raising countries of the world, as will be evident from the following figures, giving the averages for the leading countries, based on the number of persons employed :—

Country.	Quantity of coal raised per miner.	Value at the pit's mouth per ton.	Total value of coal raised per miner.	
	tons.	s. d.	£	s. d.
New South Wales .....	440	6 4	138	15 8
Great Britain .....	272	10 1	137	2 8
United States.....	536	5 6	147	8 0
Germany .....	317	7 3	114	18 3
France .....	203	11 9	119	15 3
Belgium .....	174	13 5	116	12 6
Austria .....	605	6 3	189	1 3

A large proportion of the coal raised is consumed in the state, and out of a total production of 5,942,011 tons in 1902, 2,680,552 tons—or 45·11 per cent.—were used locally. The exports to Australasian ports amounted to 1,678,725 tons, or 28·25 per cent., and to ports outside Australasia 1,582,734 tons, or 26·64 per cent. The quantity required for home consumption increases every year, and the annual consumption per head of population has risen from 16 cwt. in 1877 to 38 cwt. in 1902. The increased steam power employed in the manufacturing industries and on the railways accounts for a great deal of the advance in consumption, while the quantities of coal used in smelting works and gas works also account for a large proportion, but it must be borne in mind that the figures include the bunker coal used in the ocean-going steamers, and this amounted in 1902 to about 430,000 tons.

The progress of the export trade of New South Wales, from 1881 to 1902, is shown in the following table:—

Exported to—	Quantity.			Value.		
	1881.	1891.	1902.	1881.	1891.	1902.
	tons.	tons.	tons.	£	£	£
Australasian states .....	521,025	1,342,055	1,678,725	200,820	664,847	815,859
New Zealand .....	136,110	168,921	250,879	54,743	90,662	111,043
India, Ceylon, and China .....	136,511	188,000	99,402	59,944	105,208	48,203
Mauritius .....	6,249	19,760	10,120	2,414	10,813	5,242
Pacific Islands .....	19,526	141,055	324,743	8,011	75,803	163,513
United States .....	150,002	365,623	185,093	63,172	200,851	100,734
South America .....	8,017	221,700	489,200	3,243	123,136	265,501
Other countries .....	52,404	67,254	223,297	20,174	35,310	115,235
Total .....	1,029,844	2,514,368	3,261,459	417,530	1,306,630	1,625,380

None of the other states is in a position to export coal, but New Zealand is slowly working up an export trade, the progress of which since 1881 is shown below.

Exported to—	Quantity.			Value.		
	1881.	1891.	1902.	1881.	1891.	1902.
	tons.	tons.	tons.	£	£	£
Australasian States .....	6,049	14,277	9,060	5,022	8,488	10,605
United Kingdom .....	.....	68,871	82,399	.....	76,027	76,698
Fiji and Norfolk Island ...	21	3,282	9,476	25	2,469	7,621
Pacific Islands, etc. ....	551	5,234	87,742	563	4,189	59,823
<b>Total.....</b>	<b>6,621</b>	<b>91,664</b>	<b>188,677</b>	<b>5,610</b>	<b>91,173</b>	<b>154,747</b>

The exports to the United Kingdom from New Zealand, as well as from New South Wales, consisted entirely of bunker coal for the steamers. The production of the former colony in 1902 was 1,362,702 tons, valued at £741,759. A large proportion is raised from the mines in the Westport district of the Middle Island, which showed an output of 528,462 tons in 1902. The Otago and Greymouth districts produced respectively 308,310 and 216,594 tons.

There is a steady increase in the quantity of coal raised in the colony, and a corresponding decrease in the importation. In 1902 there were 180 coal-mines in operation in New Zealand, giving employment to 2,885 men, the average value of the output per man being £257 2s. 2d.

As showing the various kinds of coal found in New Zealand the following figures relating to the production in 1902 will be of interest :—

Bituminous coal .....	845,046 tons.
Pitch coal .....	25,245 „
Brown coal.....	427,172 „
Lignite .....	65,239 „

Total ..... 1,362,702 „

Coal-mining is an established industry in Queensland, and is progressing satisfactorily. The production increased steadily up to the year 1901, when it amounted to 539,472 tons, valued at £189,877, but in 1902 there was a decline to 501,531 tons, valued at £172,286. The collieries now in operation are situated in the Ipswich and Wide Bay districts, on the Darling Downs, and at Clermont; but deposits of coal are known to exist in the neighbourhood of Rockhampton and Gladstone, and also at various localities in Central Queensland. Operations are being conducted at the places mentioned with the view of testing and developing the seams, and the foundation of an export trade will depend on the success of the results obtained in the coastal

area. Of the total production of 501,531 tons during 1902, 390,603 tons were obtained in the Ipswich district, 105,181 tons at Wide Bay, and 5,747 tons in the Clermont district. There were 1,336 men engaged in the industry in 1902.

In Tasmania coal of good quality has been found in the Lower Measures of the Permo-Carboniferous rocks, principally in the basins of the Mersey and the Don in the north, and at Adventure Bay and Port Cygnet in the south, as well as in the Upper Measures of the Triassic or Jurassic rocks, which are extensively developed in the eastern and north-eastern parts of the state. The production of coal in the state during 1902 amounted to 48,863 tons, valued at £41,533, the output for the preceding year being 43,010 tons, valued at £21,711. The two largest collieries are the Mount Nicholas and the Cornwall, which give employment to 127 men. The work at the latter mine was greatly interfered with by a strike which occurred during the year and forced the owners to abandon their contract to supply coal to the Melbourne Harbour Trust.

Tasmania still relies largely on New South Wales for its supply of coal for local requirements. Since 1896 the export from New South Wales to the island has increased from 57,000 tons to 100,000 tons. During 1902 there were 164 men engaged in coal-mining in the State, and the average output per man amounted to 296.73 tons, valued at £253 5s.

The output of coal in Victoria is steadily increasing, and, although operations were greatly interfered with by the unfortunate strike in 1902, the output during the year was 225,164 tons, valued at £155,850, an increase of 15,835 tons on the production in 1901. In 1891 the coal produced amounted to 22,834 tons, but notwithstanding the great increase in production since that year Victoria is still a large consumer of New South Wales coal, its import in 1902 amounting to 871,066 tons. The principal collieries in the state are the Outtrim Howitt, Jumbunna, and the Coal Creek Proprietary, the output from these during 1902 being 114,685, 67,876, and 39,256 tons respectively. Boring operations are in progress, but the only seam struck during 1902 was at Boyle's Creek, near Leongatha, with a proved thickness of about 2 feet.

In South Australia, coal-beds were discovered at Leigh's Creek, north of Port Augusta, but the results of a trial on the Government railways proved the coal to be unsuitable for use. There was no output during 1902. The export of coal from New South Wales to South Australia during 1902 was 467,476 tons.

The only coal-field in Western Australia is situated at Collie, and the output in 1902 reached 140,884 tons, valued at £86,188, an increase of about 23,000 tons on the total of the preceding year. This production could be increased considerably were there sufficient demand, but at present the coal is not extensively used except on the railways.

The quantity of coal extracted annually in Australasia now exceeds 8,221,000 tons, valued at about £3,400,000. The production of each state during the year 1902 was as follows:—

State.	Quantity.	Value.	
		Total.	Proportion raised in each State.
	tons.	£	per cent.
New South Wales .....	5,942,011	2,206,598	64·82
Victoria .....	225,164	155,850	4·58
Queensland .....	501,531	172,286	5·06
Western Australia .....	140,884	86,188	2·53
Tasmania .....	48,863	41,533	1·22
Commonwealth .....	6,858,453	2,662,455	78·21
New Zealand .....	1,362,702	741,759	21·79
Australasia .....	8,221,155	3,404,214	100·00

The total quantity and value of the coal produced in Australasia up to the end of 1902 are shown below. A small quantity has been raised in South Australia, but is not yet of sufficient importance to warrant inclusion in the table:—

State.	Quantity.	Value.
New South Wales .....	103,387,070 tons	£41,701,442
Victoria .....	2,173,057 ,,	1,198,208
Queensland .....	7,197,054 ,,	2,994,275
Western Australia .....	434,974 ,,	237,160
Tasmania .....	849,127 ,,	486,998
Commonwealth .....	114,041,282 ,,	£46,618,083
New Zealand .....	17,143,210 ,,	£9,106,326
Australasia .....	131,184,492 ,,	£55,724,409

During the year 1902 this industry gave direct employment in and about the mines to the following numbers of persons in the several states:—

	No.
New South Wales .....	12,815
Victoria .....	1,303
Queensland .....	1,336
South Australia .....	50
Western Australia .....	368
Tasmania .....	164
New Zealand .....	2,885

A large proportion of the coal-mining industry of New South Wales is carried on in the Lower Hunter district, which includes the mines

in the locality of Newcastle. The following table shows the birthplaces of the miners in this district at the census of 1901, from which it will be seen that out of a total of 8,556 persons, only 3,878, or about 45 per cent. were natives of New South Wales:—

Birthplace.	No.
New South Wales .....	3,878
Other Australian States and New Zealand .....	525
England and Wales .....	2,833
Scotland .....	972
Ireland .....	173
Other British Possessions.....	15
Germany .....	45
France .....	4
Russia .....	8
Scandinavia .....	30
Italy .....	7
Other European Countries .....	11
United States .....	29
Other Countries .....	26
<b>Total.....</b>	<b>8,556</b>

The average price of coal per ton varies considerably in the states. In New South Wales, from the date of the commencement of mining to the end of the year 1902, the average price obtained has been 8s. 1d., but the mean of the last ten years has not been more than 6s. 4d. In 1902 the average price per ton of coal at the pit's mouth was as follows:—

	s.	d.
New South Wales .....	7	5
Victoria .....	13	10
Queensland .....	6	11
Western Australia.....	12	3
Tasmania .....	17	0
	<hr/>	
Commonwealth .....	7	9
New Zealand .....	10	11
	<hr/>	
Australasia .....	8	3

The question of cost of raising coal is of considerable importance in connection with the export trade. In New South Wales, miners in the Northern District were paid at the rate of 4s. 2d. per ton for screened coal, while in the Southern District the rate was 2s. 6d. In New Zealand it is computed that to deliver coal at the pit's mouth costs in labour 6s. per ton. The returns of the United States show that of the 20,172,779 tons of coal mined by manual labour, 87,841 tons were paid for by daily wages, varying from 9s. 5d. to 11s. 4d.; 600,060 tons were paid for by weight after screening at 3s. 9½d., and the balance at an average price of 2s. 3½d per ton. In 29 mines machinery was exclusively used for winning the coal and 280 machines were thus employed, while 184 machines were in use at 34 mines, in addition

to manual labour. The machine-mined coal was paid for at the rate of 1s. 8½d. per ton. In France surface workers are paid at the rate of 2s. 10½d., underground hands at 4s. 2½d., and those employed both within and without the mines at 3s. 9d. per day.

Anthracite is found in several of the Australian states, but systematic attempts to develop the deposits have as yet been restricted to Queensland. While not possessing the combustible properties or commercial value of coal, anthracite has proved a fairly efficient substitute in countries where coal is not available. The deposits in Queensland exist in the localities of the Dawson and Mackenzie Rivers, and bores have been sunk with a view of determining the best position for shafts. Two bulk samples obtained from the outcrop on the Dawson River have been tested with satisfactory results.

The following table shows the annual coal production of the principal countries of the world. The figures refer to the year 1902, except those for United States and Canada, which refer to the year 1901 :—

Country.	Tons of 2,240 lb.
United Kingdom .....	227,095,000
United States .....	261,874,000
Germany .....	105,709,000
Austria .....	10,867,000
France .....	29,099,000
Belgium .....	22,403,000
Canada .....	6,186,000
Australasia .....	8,221,000

\* Including lignite.

Kerosene shale (torbanite) is found in several parts of New South Wales. It is a species of cannel-coal, somewhat similar to the boghead mineral of Scotland, but yielding a much larger percentage of volatile hydro-carbon than the Scottish product. The richest quality yields about 100 to 130 gallons of crude oil per ton, or 17,000 to 18,000 cubic feet of gas, with an illuminating power of 35 to 40 sperm candles when gas only is extracted from the shale. The New South Wales Shale and Oil Company, at Hartley Vale, and the Australian Kerosene Oil and Mineral Company, at Joadja Creek and Katoomba, not only raise kerosene shale for export, but also manufacture from it petroleum oil and other products. From the year 1865, when the mines were first opened, to the end of 1902, the quantity of kerosene shale raised has amounted to 1,136,348 tons, worth £2,030,340. The average price realised during that period has been £1 15s. 9d. per ton. The prices ruling in 1902, when 62,880 tons were extracted, averaged 19s. per ton, representing a total value of £59,716 for the production of that year.

Extensive formations of oil shale have been found in New Zealand, in Otago, and at Orepuki, in Southland, where a mine has been opened and extensive works erected to treat the mineral for the extraction of oils, paraffin wax, ammonia, &c. The quantity of shale raised in 1901

was 12,048 tons, valued at £6,024, but during 1902 the production was only 2,338 tons, valued at £1,169. Crude petroleum has been obtained in several districts in New Zealand, and boring is in progress with a view to testing the oil-bearing strata.

The annual import of kerosene oil into Australasia, based on the returns of the last three years, is shown below :—

State.	Quantity.	Value.
New South Wales .....	4,240,966 gallons	£142,793
Victoria .....	4,667,841 "	140,290
Queensland .....	1,878,894 "	79,809
South Australia .....	1,178,747 "	35,821
Western Australia .....	1,410,246 "	46,506
Tasmania .....	362,192 "	14,589
<hr/>		
Commonwealth.....	13,738,886 "	459,808
New Zealand.....	2,897,065 "	110,949
<hr/>		
Australasia .....	16,635,951 "	570,757

#### OTHER CARBON MINERALS.

Of all the mineral forms of carbon the diamond is the purest; but as it is usual to class this precious substance under the head of gems that custom will be followed in the present instance.

Graphite, or plumbago, which stands second to the diamond in point of purity, has been discovered in New Zealand, in the form of detached boulders of pure mineral. It also occurs in impure masses where it comes into contact with the coal measures. This mineral, up to the present time, has not been found in any of the other states except New South Wales, where in 1889 a lode 6 feet wide, but of inferior quality, was discovered near Undercliff, in the New England district; and in Western Australia, where, however, owing principally to difficulties of transit, very little of it has been worked.

Ozokerite, or mineral wax, is reported to have been found at Coolah, in New South Wales.

Elaterite, mineral caoutchouc, or elastic bitumen, is said to have been discovered in New South Wales and South Australia. In the last-named state a substance very similar to elaterite has been discovered in the Coorong Lagoons, and has received the name of coorongite. Up to the present time neither the extent of these finds nor their commercial value has been ascertained.

Bitumen is known to exist in Victoria, and is reported to have been found near the township of Coonabarabran, in New South Wales.

Kauri gum, a resinous substance somewhat resembling amber in appearance, and like that product an exudation from trees, is found only in the Auckland province of New Zealand, and is included under the head of minerals, although more logically entitled to be considered as a vegetable product. The best is that dug out of the ground;

but considerable quantities of inferior grades are taken from the forks of standing trees. In New Zealand an extensive and lucrative commerce is carried on in kauri gum. It is computed that the total value of this product obtained from 1853 to the end of 1902 was £11,226,168. In the year 1902 the quantity obtained represented a value of £450,223, and gave employment to about 7,000 persons, both European and Maori. Kauri gum is included in the figures in this chapter giving the total mineral production.

#### SALTS.

Common rock salt has been found in rock crevices in several parts of New South Wales, but it is not known to exist in deposits large enough to be of commercial importance. Large quantities of salt are obtained from the salt lakes in South Australia by means of evaporation. The principal source of supply is Lake Fowler, and in summer the entire area is covered with a deposit of salt. In 1902 there were 300 persons engaged collecting and refining salt, and the quantity produced during the year amounted to 41,500 tons, valued at £45,650.

Natron is said to occur in the neighbourhood of the Namoi River, in New South Wales. It appears as a deposit from the mud-wells of that region. Epsomite, or epsom salt (sulphate of magnesia), is seen as an efflorescence in caves and overhanging rocks of the Hawkesbury sandstone formation, and is also found in various other parts of New South Wales.

Large deposits of alum occur close to the village of Bulladelah, 30 miles from Port Stephens, New South Wales. Up to the end of the year 1902, 19,386 tons of alunite had been raised in the locality, most of the product having been sent to England for treatment. During 1902 the Bulladelah mine yielded 3,644 tons of stone, valued at £10,932.

#### STONES AND CLAYS.

Marble is found in many parts of New South Wales, South Australia, New Zealand, and Tasmania. In New South Wales marble quarries have been opened in several districts, and some very fine specimens of the stone have been obtained.

The Hawkesbury sandstone formation, which underlies the city of Sydney, provides an inexhaustible supply of stone admirably adapted for building purposes, and capable of lending itself to fine architectural effects.

Lithographic stone has been found in New Zealand, where another beautiful species of limestone known as Oamaru stone is also procured. This stone has a fine, smooth grain, and is of a beautiful creamy tint. It is in great demand for public buildings, not only in the colony where it is found, but in the great cities of continental Australia, which import quantities of the stone for the embellishment of public edifices.

Limestone is mined for in New South Wales, and is now being largely used in the manufacture of hydraulic cement, as well as



for fluxing purposes in smelting works. At Portland, near Wallerawang, extensive works for manufacturing cement have been erected, and works are also in operation at Granville, near Sydney. In other parts of the state limestone is also raised, the total production in 1902 being 20,054 tons, valued at £16,018. Of this quantity 17,352 tons were used in smelting works. In Western Australia a considerable quantity of limestone is raised for fluxing purposes, the production in 1902 being 5,080 tons, valued at £1,340. The establishment of the cyanide process for the recovery of gold, in which lime is freely used, has led to the opening up of limestone mines in various parts of Queensland, and the production in 1902 amounted to 4,743 tons, valued at £3,672, the total production up to the end of that year being 14,921 tons, valued at £12,435.

Gypsum is found crystallised in clay-beds in New South Wales, and in isolated crystals in the Salt Lakes of South Australia, where a small proportion of sulphate of lime is present in the water. It is also found in portions of Victoria, the production in that state for 1902 being 3,227 tons, valued at £3,630. This mineral is of commercial value for the manufacture of cement and plaster of Paris, and also as a fertiliser. A considerable quantity has been raised in South Australia for the latter purpose. Gypsum is also found in the form of an insoluble salt in New South Wales, Victoria, and New Zealand.

Apatite, another mineral of considerable commercial importance, and very valuable as a manure, occurs in several districts of New South Wales, principally on the Lachlan River, at the head of the Abercrombie, and in the Clarence River district.

Quartz is of common occurrence in all parts of Australasia. Rock crystal, white, tinted, and smoky quartz are frequently met with, as well as varieties of crystalline quartz, such as amethyst, jasper, and agate, which possess some commercial value.

Tripoli, or rotten stone, an infusorial earth, consisting of hydrous silica, which has some value for commercial purposes, has been found in New South Wales, Victoria, and New Zealand. Meerschaum is reported to have been discovered near Tamworth and in the Richmond-River district, in New South Wales.

Mica is also found in granitic country, and has been discovered in the New England and Barrier districts of New South Wales. In Western Australia very good mica has been found at Bindoon, and also on the Blackwood River, near Cape Leeuwin. Several attempts at mining were made, but they proved unsuccessful, and have been abandoned. Deposits have also been found near Herberton, in Northern Queensland. In the Northern Territory of South Australia mica has been obtained on a small scale. In 1895 the production was valued at £2,638, and in 1896 at £732; but of late years there has been no production.

Kaolin, fire-clays, and brick-clays are common to all the states. Except in the vicinity of cities and townships, however, little use has

been made of the abundant deposits of clay. Kaolin, or porcelain clay, although capable of application to commercial purposes, has not as yet been utilised to any extent, though found in several places in New South Wales and in Western Australia.

Asbestos has been found in New South Wales in the Gundagai, Bathurst, and Broken Hill districts—in the last-mentioned district in considerable quantities. Several specimens of very fair quality have also been met with in Western Australia; and the Government of the state offered a bonus not exceeding £500 for the export of 50 tons of asbestos, of a value of not less than £10 per ton. In Tasmania asbestos is known to exist in considerable quantities in the vicinity of Beaconsfield.

In New Zealand fairly extensive deposits of phosphates have been discovered, and with large supplies of this valuable fertiliser near at hand the necessity for importing phosphatic manures should shortly cease to exist.

#### GEMS AND GEMSTONES.

Many descriptions of gems and gemstones have been discovered in various parts of the Australasian states, but systematic search has been made principally for the diamond and the noble opal.

Diamonds are found in New South Wales, Victoria, Queensland, and South Australia, but only in the first-named state have any attempts been made to work the diamond drifts. The existence of diamonds and other gem-stones in the territory of New South Wales had been known for years before an attempt was made to work the deposits in 1872. In the course of the following year several deposits of adamantine wash were discovered at Bingara, in the New England district, and in later years at Boggy Camp, Copeton. The output has never been very considerable, the largest value realised in any year being £15,375. In 1899 the value amounted to £10,350; the output declined in the next two years, but increased to £11,326 in 1902. The total value of the diamonds produced up to the end of 1902 was £76,617; but this amount is believed to be considerably understated.

The finest opal known is obtained in the Upper Cretaceous formation at White Cliffs, near Wilcannia, New South Wales. During the year 1895 good stone was found at a depth of 50 feet, and as the lower levels are reached the patches of opal appear to improve in quality and to become more regular and frequent. On block 7 a patch of stone was found which realised over £3,000. It is difficult to state with exactitude the value of the production, but it is believed that stone to the value of £716,600 has been sold up to the end of 1902. In 1901 a Special Commission was appointed to inquire into matters connected with the opal industry at White Cliffs, and their investigations tended to show that the annual value of production for some years had

amounted to £100,000. Despite the fact that operations were hampered in 1902 by lack of water, the production for the year was valued at £140,000. The number of men engaged in the opal mining industry was 1,100.

In Queensland opal is found in rocks of the desert sandstone formation, sometimes on the surface, but generally at a depth of about 14 feet. The chief fields are at Cunnamulla, Paroo, and Opalton, in the far western and north-western parts of the State, but the scanty water supply has been a great barrier to the progress of the industry. During 1902 the production was valued at £7,000, and the total up to the end of that year, at £138,845

Other gem-stones, including the sapphire, emerald, oriental emerald, ruby, opal, amethyst, garnet, chrysolite, topaz, cairngorm, onyx, zircon, etc., have been found in the gold and tin-bearing drifts and river gravels in numerous localities throughout the states. The Emerald Proprietary Company, in the Emmaville district, near Glen Innes, New South Wales, have sunk two shafts, 100 feet and 50 feet respectively; and 25,000 carats have been won in a rough state. Their value when cut and finished, if of the best quality, is about £2 per carat. Owing to the difficulties of extraction, and the low price of the gems in the London market, the mines were closed for three years. In 1897 they were again opened up, and, although worked for some time during 1898, they are now closed, the company having obtained a suspension of the labour conditions. No gems were produced during the year.

The sapphire is found in all the states, and considerable attention has lately been directed to the sapphire fields of Anakie, in Queensland. The fields are extensive, but the gems are of a peculiar colour, quite distinct from those of any other country, a characteristic that prejudicially affects their value. The value of the gems produced in 1901 was £6,000, but owing to the low prices and the lack of sufficient water supply on the field, the returns fell away to £5,000 in 1902. The oriental topaz has been found in New South Wales. Oriental amethysts also have been found in that State; and the ruby has been found in Queensland, as well as in New South Wales.

According to an authority on the subject of gemstones, rubies, oriental amethysts, emeralds, and topaz have been chiefly obtained from alluvial deposits, but have rarely been met with in a matrix from which it would pay to extract them.

Turquoises have been found near Wangaratta, in Victoria.

Chrysoberyls have been found in New South Wales; spinel rubies, in New South Wales and Victoria; white topaz, in all the states; and yellow topaz, in Tasmania. Chalcedony, carnelian, onyx, and cat's-eye are found in New South Wales; and it is probable that they are also to be met with in the other states, particularly in Queensland. Zircon, tourmaline, garnet, and other gemstones of little commercial value are found throughout Australasia.

In South Australia some very fine specimens of garnet were found, causing some excitement at the time, as the gems were mistaken for rubies. The stones were submitted to the examination of experts, whose reports disclosed the true nature of the gems, and dispelled the hopes of those who had invested in the supposed ruby-mines of that state.

#### PRODUCTION OF MINERALS.

The foregoing pages show that Australasia possesses invaluable mineral resources, and although enormous quantities of minerals of all kinds have been won since their first discovery, yet the deposits, with the exception perhaps of gold, silver, and coal have only reached the first period of their exploitation. The development of the deposits of various other minerals has not reached a sufficiently advanced stage to enable an exact opinion to be expressed regarding their commercial value, though it is confidently held by mining experts that this must be enormous. The mineral production of the various states in 1902 will be found below:—

State.	Total Value.	Proportion in each State.	Average value per head.
	£	per cent.	£ s. d.
New South Wales .....	5,078,029	20·35	3 12 1F
Victoria .. .....	3,288,908	13·18	2 14 6
Queensland .....	3,310,600	13·27	6 9 2
South Australia .....	576,374	2·31	1 11 7
Western Australia .....	8,094,617	32·44	39 9 8
Tasmania.....	1,383,568	5·54	7 17 6
Commonwealth .....	21,732,096	87·09	5 12 7
New Zealand .....	3,221,622	12·91	4 0 9
Australasia .....	24,953,718	100·00	5 7 2

The total value of the minerals raised in Australasia during 1902 was £24,953,718, being £18,289 below the value for 1901, which is the highest recorded in any one year. The great advance of gold-mining in Western Australia and the increased activity displayed in coal-mining in New South Wales have been the chief contributing factors in maintaining the high figures of the past few years. Gold has always constituted the largest proportion of the value raised, but the search for this mineral has led to the expansion of other branches of the mining industry which are commanding more attention each year. At the present time the number of persons in Australasia who gain their

livelihood by mining is nearly 123,000. The total employment in each branch of mining during 1902 was :—

State.	Number of Persons engaged in Mining for—						Total.
	Gold.	Silver and Lead.	Copper.	Tin.	Coal, Coke, and Shalc.	Other Minerals & Precious Stones.	
New South Wales ....	10,610	5,382	1,609	1,288	13,114	1,602	33,605
Victoria .....	26,103	.....	.....	.....	1,303	73	27,479
Queensland .....	9,045	100	666	1,467	1,336	328	12,942
South Australia.....	2,000	150	4,100	.....	50	750	7,050
Western Australia....	20,476	2	113	249	368	2	21,210
Tasmania .....	1,038	.....	*3,780	1,254	164	.....	6,236
Commonwealth ..	69,272	5,634	10,358	4,258	16,335	2,755	108,612
New Zealand .....	*11,393	.....	.....	.....	2,885	.....	14,283
Australasia .....	80,670	5,634	10,358	4,258	19,220	2,755	122,895

\* Includes silver miners.

The greatest number of persons engaged in mining is in New South Wales, where, owing to the large employment afforded by the coal-mines, the total is 33,695; the greatest number of gold-miners is in Victoria. The total number of persons in the Commonwealth engaged in mining pursuits is 108,612, and in view of the known resources which await development, this number is likely to be still further increased.

The following table shows the value of the mineral production of each state during the five years 1871, 1881, 1891, 1901 and 1902, as well as the value per inhabitant for the whole of Australasia :—

State.	1871.	1881.	1891.	1901.	1902.
	£	£	£	£	£
New South Wales.....	1,650,000	2,121,000	6,396,000	5,854,150	5,078,029
Victoria .....	5,400,000	3,467,000	2,339,000	3,312,162	3,288,908
Queensland .....	806,000	3,165,000	2,300,000	3,114,702	3,310,600
South Australia.....	725,000	421,000	366,000	613,930	576,374
Western Australia .....	5,000	11,000	130,000	7,445,772	8,094,617
Tasmania .....	25,000	604,000	516,000	1,675,290	1,383,568
Commonwealth .....	8,611,000	9,789,000	12,047,000	22,016,006	21,732,096
New Zealand.....	3,100,000	1,523,000	1,841,000	2,956,001	3,221,622
Australasia { Total .....	11,711,000	11,317,000	13,888,000	24,972,007	24,953,718
Australasia { Per head ..	£ s. d. 6 1 0	£ s. d. 4 1 6	£ s. d. 3 12 3	£ s. d. 5 9 0	£ s. d. 5 7 2

The foregoing table shows that the mineral production of 1902 was over eleven millions more than that of 1891. There were increases in all the states with the exception of New South Wales, in which state a decrease of slightly over £1,318,000 has to be recorded, owing to the fall in the value of silver and lead. The most notable increases were in Western Australia and Tasmania; the production of the former state exceeded that of 1891 by nearly £7,965,000, mainly on account of the great increase in the gold yield, which advanced in value from £115,182 to £7,947,662 during the period under review. The large expansion in the Tasmanian production was due to the output of the Mount Lyell Copper-mines. In the other states, the increases were also substantial, and New Zealand had an increase of £1,380,000.

Comparing the value of the mineral production in 1902 with the population, the largest amount is shown by Western Australia, with £39 9s. 8d. per inhabitant; Tasmania ranks second, with £7 17s. 6d. per inhabitant; Queensland third, with £6 9s. 2d.; New Zealand fourth, with £4 0s. 9d.; New South Wales fifth, with £3 12s. 11d. Victoria follows with an average of £2 14s. 6d. per head, and in South Australia the production per inhabitant was only £1 11s. 7d. The average per inhabitant for Australasia was £5 7s. 2d., and the average for the states constituting the Commonwealth was £5 12s. 7d. per head.

The following table shows the value of production in each of the states during 1902, distinguishing the principal minerals. With regard to some of the states the data are defective in respect to "other minerals," but not to such an extent as to seriously affect the gross total. The column "other minerals" includes kerosene shale in New South Wales and kauri gum in New Zealand, but does not include salt in South Australia:—

State.	Gold.	Silver and Silver-lead.	Copper.	Tin.	Coal.	Other Minerals.	Total.
	£	£	£	£	£	£	£
New South Wales . . . . .	684,970	1,440,179	307,806	59,593	2,206,598	378,883	5,078,029
Victoria . . . . .	3,062,028	4,900	.....	500	155,850	65,630	3,288,908
Queensland . . . . .	2,720,639	70,145	189,200	116,171	172,286	42,159	3,310,600
South Australia . . . . .	95,129	19,740	432,525	6,078	.....	22,902	576,374
Western Australia . . . . .	7,947,662	9,467	8,090	39,783	86,188	3,427	8,094,617
Tasmania . . . . .	301,673	218,864	577,533	242,990	41,533	1,075	1,383,568
Commonwealth . . . . .	14,812,001	1,763,295	1,515,154	465,115	2,662,455	514,076	21,732,096
New Zealand . . . . .	1,951,433	71,975	.....	.....	741,759	*456,455	3,221,622
Australasia . . . . .	16,763,434	1,835,270	1,515,154	465,115	3,404,214	970,531	24,953,718

\* Inclusive of kauri gum of the value of £450,223.

The total mineral production to the end of 1902 is shown in the following table, in which the column "other minerals" again includes kerosene shale and kauri gum :—

State.	Gold.	Silver and Silver-lead.	Copper.	Tin.	Coal.	Other Minerals.	Total.
	£	£	£	£	£	£	£
New South Wales ..	49,844,135	33,781,756	6,164,879	6,661,399	41,701,442	4,678,830	142,832,441
Victoria .....	263,551,229	861,439	206,395	715,998	1,108,208	411,661	266,044,930
Queensland .....	55,472,314	858,187	2,438,802	4,810,037	2,994,275	362,569	66,936,274
South Australia .....	2,483,326	138,370	23,254,571	38,758	.....	532,444	26,447,469
Western Australia ..	38,097,374	21,072	335,062	237,982	237,160	417,809	39,346,459
Tasmania .....	5,195,161	2,603,750	4,499,028	7,519,284	486,998	338,007	20,642,228
Commonwealth ..	414,643,539	38,264,574	36,898,827	19,983,458	46,618,083	6,741,320	563,149,801
New Zealand .....	61,111,316	452,781	18,088	.....	9,106,326	*11,487,002	82,175,513
Australasia .....	475,754,855	38,717,355	36,916,915	19,983,458	55,724,409	18,228,322	645,325,314

\* Inclusive of kauri gum of the value of £11,226,168.

Coal was the only mineral raised in New South Wales prior to 1852, and its production up to that date was valued at £279,923. Deducting that amount from the total value of Australasian minerals raised up to the end of 1902, the remainder, £645,045,391, represents the value of mineral production from 1852, equal to an average of £12,647,949 per annum for the fifty-one years.