MINERAL RESOURCES.

ALMOST 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 over 494 million pounds sterling has been obtained in Australasia. Towards this total Victoria has contributed nearly 267 millions, and for many years that state was the largest gold producer of Australasia. In the year 1898, 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 1903 the output was valued at £8,770,720, as against £3,259,483 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 four years it has been somewhat smaller, although the value has exceeded £3,000,000 annually. The yield for 1903 was 822,424 oz., equal to 767,351 oz. fine, valued at £3,259,483. The Bendigo district was again the chief centre of production, with 224,747 oz., followed by Ballarat with 174,817 oz., and Beechworth with 116,886 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 1903 was 219,820 oz., and of the latter 55,800 oz. Of the total yield of the state 42,066 oz. were obtained by means of dredging and hydraulic sluicing. There were 51 dredging plants in operation during the year, comprising 15 bucket dredges, 23 pump hydraulic sluices, 10 jet elevators, and 3 rotary hydraulic plants, while 14 others were engaged in hydraulic sluicing by gravitation. The men employed in this branch of the mining industry numbered upwards of 1,100. The total number of men engaged in gold-mining on the 31st December, 1903, was 25,208, of whom 11,058 were alluvial miners, and 14,150 quartz miners. The machinery and plant in use on the same date were valued at £2,040,690.

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 is steadily advancing. 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, but a considerable quantity was made up of gold obtained from old tailings, and from creeks which had served as channels for the escape of residue from the mills. In 1901 the yield was valued at £2,541,892, and in 1902 at £2,720,639, but these totals were exceeded in 1903, when the production was 921,363 oz., or 668,546 oz. fine, valued at £2,839,813.

Arranged in order of productiveness, the principal goldfields in Queensland in 1903 were Charters Towers, Gympie, and Mount Morgan, 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 last two years have been amongst 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, and in 1903 to 285,771 oz. fine, valued at £1,213,879. 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, have been mainly responsible for the increased activity in the mining operations. The gold obtained from this mine alone in 1903 amounted to 78,303 oz. Over 200 men were employed and dividends amounting to £215,000 were paid. Of the mines engaged on the Day Dawn reef, the most important in point of production has hitherto been the Day Dawn Block and Wyndham, which has returned dividends amounting to £761,460, but the output is gradually becoming smaller, and in 1903 was only 17,018 oz., being considerably below that of previous years. Scarcity of water has been the chief drawback to mining operations at Charters Towers, but this difficulty was overcome by the construction of a weir across the Burdekin River, thus ensuring a constant supply. The yield from the Mount Morgan field amounted to 124,975 oz., or 116,672 oz. fine gold, valued at £495,592, or £111,122 less than in the preceding year. The Mount Morgan mine was responsible for almost the whole of the production, and yielded 120,391 oz. of gold, obtained from 238,801 tons of stone. Up to the 30th November, 1903, no less than 2,678,922 oz. of gold, valued at £10,874,553, had been obtained from this mine. The machinery employed at the Mount Morgan mine on the 31st December, 1903, was valued at £452,800, and about 1,600 hands were engaged at the mine and works. The yield of the Gympie mining district, in 1903, surpassed that of the previous year, which had hitherto ranked as the highest, and amounted to 147,622 oz. fine gold, with a value of £627,056. The chief contributing mines were the No. 2 South Great Eastern, Scottish Gympie, and South Glanmire and Monkland, which produced 52,010 oz., 39,479 oz., and 27,290 oz. of gold, and paid dividends amounting to £115,200, £53,625, and £70,500 respectively. In September, 1903, a discovery of alluvial gold in the bed of the Dee River, about 7 miles above Mount Morgan, was reported, and up to the end of the year gold to the value of £7,658 had been obtained.

There were 1777 quartz miners and 29 alluvial miners on this field at the close of 1903, the total population being estimated at 15,550 persons. The Ravenswood gold-field, which had been comparatively neglected for some years, again attracted attention owing to rich discoveries made in 1902, and during that year the production amounted to 40,969 oz. fine gold, valued at £174,034, while in 1903 the yield was 38,273 oz. fine gold, with a value of £162,572. The New Ravenswood, Limited, owns the principal mines on the field, including the Sunset, from which 19,599 oz. of gold were obtained during the year. There were 912 quartz miners and 37 alluvial miners on the

field at 31st December, 1903, in addition to 39 engaged in mining for other minerals, the total population being estimated at 4,800.

The yield of the Croydon field amounted to 31,790 oz. fine gold, valued at £135,036. The number of men engaged in gold mining at this field on the 31st December, 1903, was 425, the total population being 2,708. The machinery in use was valued at £72,400. The men engaged in gold-mining in Queensland at the end of 1903 numbered 9,229, of whom 7,278 were quartz-miners and 1,951 alluvial miners, 494 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 there was a diminished production due to the scarcity of water, but with the more favourable season of 1903 there was a revival of the industry, and the yield amounted to 254,260 oz. fine, valued at £1,080,029, making the total up to the end of that year £50,924,164. The uncertainty of the water supply has always been the chief drawback to mining in New South Wales, as well as in other states of the Commonwealth, and the effects of a good or bad season can be readily seen in the gold yield of the year. Of the gold produced in 1903, 27,237 oz., valued at £104,303, were obtained by dredging, the output from this branch of the industry showing an increase of £6,412 on that of the previous year. On the 31st December, 1903, there were 41 dredging plants in commission, valued at £253,480. The chief centre of gold-dredging is in the Araluen Division, where fourteen plants were in operation, and gold to the value of £54,990 was obtained. The area held and applied for under lease for gold dredging was 9,015 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 1903 being valued at £266,355. The next in importance was Wyalong, with £72,847; followed by Araluen, £58,163, and Adelong, £43,258. These totals are but small compared with those returned from several of the districts in other states, while the mines are less productive than those of Western Australia and Queensland. The principal mine in the state is that at Mount Boppy, near Cobar, which is of comparatively recent development. 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 1903 was £953,970. The men engaged in the industry numbered 11,247, of whom 5,341 were quartz miners and 5,906 alluvial miners, the latter including 391 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 1903, being East Coolgardie, Mount Margaret, and North Coolgardie, in the eastern district; and Murchison, in the central district. For the past six 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 1902 was 2,177,441 oz., representing 1,871,037 oz. fine, with a value of £7,947,662, and ranked as the highest recorded up that year; but this return was exceeded in 1903 when the production amounted to 2,436,311 oz., or 2,064,801 oz. fine, valued at £8,770,720. Of the total yield in 1902, no less than 1,358,375 oz. were obtained from the East Coolgardie field, where some of the richest mines in the world are to be found. The dividends

returned by some of the gold-mining companies in 1903 were enormous, the total being £2,024,152. Of this amount the Great Boulder Perseverance paid £350,000, the Golden Horseshoe £270,000, the Great Boulder Proprietary £262,500, and the Great Fingall £200,000. 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 1903 was 20,716, comprising 15·2 of the whole male population, while the machinery in use was valued at £4,532,737.

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 1903 the total amounted to 533,314 oz., valued at £2,037,831, the highest recorded since 1871. Up to the 31st December, 1903, gold to the value of £63,149,147 has been raised in the colony. The largest proportion of the yield in 1903 was obtained in the Auckland district; the value of the gold entered for exportation from each district being:—Auckland, £832,334; Otago, £668,852; West Coast, £501,090; Nelson, £31,710; and Marlborough, £3,845. In earlier years by far the greater portion of the yield was won in alluvial mining, but at the present time a large proportion of the production is obtained from quartz reefs which are widely distributed throughout the colony. The older methods of alluvial mining have practically passed away owing to the exhaustion of the rich, shallow grounds, and have been superseded by hydraulic sluicing, while dredging is also carried on in numerous localities. During 1903 efforts were made to test the ground on the Thames field, one of the oldest in the colony, by boring, but operations were suspended owing to the failure of the plant. The Auckland district is the principal seat of quartz mining in the colony, and the chief centre of production is at Waihi. Here are located the mines of the Waihi Gold Mining Company, which rank amongst the principal mines of the world. During 1903, 214,508 tons of stone were treated at the mills, and yielded 677,873 oz., while from the concentrates and slag tailings exported for treatment gold to the value of £83,722 was obtained, making a total of £603,167. The company employed over 1,100 hands, and paid dividends to the amount of £250,000 during the year, the total paid since the commencement of operations being upwards of £1,260,000. From Karangahake, gold valued at £182,095 was won, the mines and mills affording employment to 452 persons. The principal mines in this district are the New Zealand Crown and the Talisman Consolidated, which yielded gold to the value of £78,280 and £94,134 respectively. The principal seat of quartz mining in the Middle Island is at Reefton, where upwards of 500 persons are employed. The gold obtained in this district amounted to 55,719 oz., valued at £222,743,

of which 48,841 oz., valued at £195,469, were obtained from quartz mines; 3,937 oz., valued at £15,798 by dredging; and 2,941 oz., of a value of £11,476, from other alluvial sources. The chief mines in the district are the Progress mines, from which 57,114 tons of quartz were obtained in 1903, yielding 21,299 oz. of gold, valued at £88,738. From concentrates, &c., £19,621 worth were won. The dividends for the year amounted to £34,375.

Considerable attention is directed to the recovery of gold by dredging, and at the end of 1903 there were 201 dredges in operation. The men engaged in gold-mining at the end of 1903 numbered 10,210, of whom 6,613 were alluvial miners and 3,597 were quartz miners, 1,021 of the former being Chinese. The machinery employed in 1903 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; but in 1903 it decreased to 59,891 oz. fine, valued at £254,403. 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 31st December, 1903, had yielded 579,694 oz. 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 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 198,818 oz. of gold, valued at about £758,378, and up to 31st December, 1903, had paid £334,400 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 have been made to recover gold by the process of dredging, but the results, so far, have not been satisfactory, although the Lisle Dredging Company obtained 356 oz. by this process during the half-year ended 31st December, 1903. The men engaged in gold-mining during 1903 numbered 988.

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 £2,573,000. 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 six

years. In the state proper the yield is very small, amounting to but 8,650 oz. in 1903, the balance of 19,179 oz. being obtained from the Northern Territory, the total value amounting to £90,031. The North-western District, which includes Tarcoola, is the most important gold-producing area in the state. The output for 1903 was 4,629 oz. 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 Government battery and cyanide plant on the field treated 1,878 tons of ore during the year, which yielded 2,019 oz. of gold, valued at £7,562. 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 1903 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 and the proportion of the total amount raised in each state up to the end of 1903 :—

State.	Production of Gold.	
	Value.	Proportion raised in each State.
	£	per cent.
New South Wales	50,924,164	10·31
Victoria	266,810,712	54·00
Queensland	58,312,127	11·80
South Australia	2,573,357	0·52
Western Australia	46,868,094	9·49
Tasmania	5,449,564	1·10
Commonwealth	430,938,018	87·22
New Zealand	63,149,147	12·78
Australasia	494,087,165	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	.....	.....	.....	.....	1,048,884	.....
1852	2,660,946	10,953,936	.....	.....	.....	.....	13,614,882	.....
1853	1,781,172	12,600,084	.....	.....	.....	.....	14,381,256	.....
1854	773,209	9,568,260	.....	.....	.....	.....	10,341,469	.....
1855	654,594	11,172,260	.....	.....	.....	.....	11,826,854	.....
1856	689,174	11,942,940	.....	.....	.....	.....	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	1,259,127	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	1,591,389
1863	1,796,170	6,508,420	30,000	880	.....	.....	8,335,470	2,431,723
1864	1,304,926	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	.....	.....	4,382	7,113,049	2,844,517
1867	1,053,578	5,732,984	170,090	.....	.....	2,536	6,959,188	2,698,862
1868	994,665	6,536,800	429,907	2,936	.....	514	7,964,822	2,504,326
1869	974,149	5,349,184	451,352	15,593	.....	7,475	6,797,753	2,362,995
1870	931,016	4,891,192	351,412	24,217	.....	14,218	6,212,055	2,157,585
1871	1,250,485	5,421,908	504,876	6,000	.....	16,055	7,199,324	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	5,876,100	1,407,770
1876	613,190	3,855,040	660,136	9,888	.....	44,923	5,183,177	1,284,328
1877	471,448	3,238,612	838,544	.....	.....	23,289	4,571,893	1,496,080
1878	430,200	3,101,088	1,085,864	1,225	.....	100,000	4,718,377	1,240,079
1879	407,219	3,035,788	1,009,946	90	.....	230,895	4,683,938	1,148,103
1880	444,253	3,316,484	934,976	.....	.....	201,297	4,897,010	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	468,530	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	4,841,653	921,797
1885	378,665	2,940,872	1,038,294	88,709	.....	155,309	4,651,849	948,615
1886	366,294	2,660,784	1,193,493	95,674	1,148	117,250	4,434,643	903,569
1887	304,579	2,471,004	1,490,730	138,302	18,517	158,533	4,671,665	811,100
1888	317,241	2,500,104	1,685,750	66,160	13,273	147,154	4,729,682	801,066
1889	434,784	2,459,356	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	86,664	87,114	5,231,466	773,438
1891	559,231	2,305,600	2,017,536	125,529	115,182	149,816	5,272,894	1,007,488
1892	575,299	2,617,824	2,154,453	139,370	226,284	174,070	5,887,300	954,744
1893	651,286	2,634,504	2,159,290	153,132	421,385	145,875	6,215,472	913,138
1894	1,156,717	2,694,720	2,378,289	152,092	787,099	225,485	7,394,402	887,839
1895	1,316,929	2,960,344	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	980,204
1898	1,201,743	3,349,028	2,750,349	95,143	3,990,698	281,485	11,668,446	1,080,691
1899	1,623,320	3,413,000	2,838,119	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	6,007,610	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	3,062,028	2,720,639	95,129	7,947,662	301,573	14,812,001	1,951,433
1903	1,080,029	3,259,483	2,839,813	90,031	8,770,720	254,403	16,294,479	2,037,831

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 1903 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	295,778	254,260	1,080,029	5·89
Victoria	822,424	767,351	3,259,483	17·78
Queensland	921,363	668,546	2,839,813	15·49
South Australia	27,829	21,195	90,031	0·49
Western Australia	2,436,311	2,064,801	8,770,720	47·84
Tasmania	.....	59,891	254,403	1·39
Commonwealth	.....	3,836,044	16,294,479	88·88
New Zealand	533,314	479,749	2,037,831	11·12
Australasia	.....	4,315,793	18,332,310	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 £230 6s 3d 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	11,247	22·61	96 0 7
Victoria	25,208	30·44	129 6 1
Queensland	9,229	72·44	307 14 1
South Australia	2,000	10·60	45 0 4
Western Australia	20,716	99·67	423 7 7
Tasmania	988	60·62	257 9 10
Commonwealth	69,388	55·28	234 16 7
New Zealand	10,210	46·99	199 11 10
Australasia	79,598	54·22	230 6 3

The most extensive development of quartz-reefing is found in Victoria, some of the mines being of a great depth. At the end of 1903 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.

In Queensland, the West of Scotland mine, on the Gympie field, is worked at a depth of 3,156 feet, while several others exceed 2,000 feet in depth.

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 £6,304,000 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 November, 1903, 2,678,922 oz. of gold had been won from 2,110,067 tons of ore, yielding an average of 1 oz. 5 dwt. 9 gr. per ton of ore treated.

For the ten years ended 1903, the world's production of gold is estimated to have been as follows:—

Year.	Value.	Year.	Value.
	£		£
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
1898	58,137,000	1903	67,500,000

Of the world's production of £67,500,000 in 1903, Australasia raised 27·16 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 1903 was valued at £1,066,114 ; while the machinery employed was valued at £610,000. 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 silver-lead ore from the mines in the Barrier country to the end of the year named was valued at £32,011,187. 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 numerou leases, held by mining companies and syndicates.

The Broken Hill Proprietary Company holds the premier position. It possesses 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, 1904, the company treated 7,134,526 tons of silver and silver-lead ores, producing 124,552,679 oz. of silver and 663,423 tons of lead, valued in the London market at £26,896,000. Dividends and bonuses to the amount of £7,760,000 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 £1,308,746. The mine wages and salary sheet for the twelve months represented a sum of £573,563, including £175,261 paid to contractors. The net profit for the year was £179,782.

The quantity and value of silver and silver-lead ore exported by New South Wales to the end of 1903 is shown in the following table :—

Year.	Silver.		Silver-Lead.			Total value.
	Quantity.	Value.	Quantity.		Value.	
			Ore.	Metal.		
Up to 1882	oz. 765,397	£ 187,429	tons cwt. 203 12	tons cwt.	£ 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	202,789	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
1903	1,099,373	113,755	330,581 7	18,483 2	1,387,648	1,501,403
Total	12,187,927	1,832,100	3,704,950 17	462,862 12	33,451,059	35,283,159

This amount was approximately made up of 160,996,160 oz. of silver, valued at £24,724,963; and of 844,387 tons of lead, valued at £10,558,196. 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, and as a consequence, all but four of the principal Barrier mines temporarily suspended 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 three years ended with 1902. 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. The position improved in 1903, when the prices were slightly better, and the value of the output for the year showed an increase of £60,000; the men engaged numbered 6,035, and the average value per man amounted to £248 15s. 8d.

In addition to several others of a minor character, 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 are principally engaged in treating silver ores, and have proved of great service to the mining communities 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 55,587 tons, the metal obtained being as follows :—

Gold	22,567 oz.
Silver	1,286,185 oz.
Lead	22,087 tons.
Copper	204 tons.
Spelter	286 tons.

The number of men employed on these works at the end of 1903 was 891.

The only other state where silver has been produced to any extent is Tasmania. The industry has been steadily developed, and the production increased from £5,838 in 1888 to £293,043 in 1894. In 1903 the value was £193,246, in addition to lead valued at £75,280.

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 and British 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 during the half-year ended 31st December, 1903, 364,288 oz. fine silver, valued at £39,974, were obtained from this mine. This, together with the output from the mines first mentioned, and 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 mixed with copper in sight, in addition to extensive deposits of zinc.

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 silver and lead to the value of £9,241 were obtained during

1903. The last three years have witnessed a remarkable increase in the production of silver, despite the fall in prices. In 1900 the value of the production was only £12,712, but during 1901 it increased to £62,241, and in 1902 it reached £70,145, which is the highest value recorded since 1887, when it amounted to £80,092. The output of the preceding year was not quite maintained during 1903, but amounted to 642,125 oz., valued at £65,538. 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 1903, 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 1903 was 911,914 oz., valued at £91,497.

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 1903 the value of the silver produced in Western Australia was only £19,153, and in Victoria £2,880. The production of silver in South Australia is not large, the value in 1903 being £2,071, 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 1903 New South Wales had produced 86·8 per cent. of the total value of silver raised in Australasia; Tasmania came second with 7·1 per cent.; and of the remaining small proportion, Queensland claimed the largest share. The total production of silver in Australasia in 1903, and up to the end of that year, was as follows:—

State.	Value of Silver produced—	
	During 1903.	To end of 1903.
	£	£
New South Wales	1,501,403	35,283,159
Victoria	2,880	864,319
Queensland	65,538	923,725
South Australia	2,071	140,441
Western Australia	19,153	40,225
Tasmania	268,526	2,872,276
Commonwealth	1,859,571	40,124,145
New Zealand	91,497	544,278
Australasia	1,951,068	40,668,423

The world's production of silver during the ten years ended 1903 is estimated to have been as follows :—

Year.	Ounces.	Year.	Ounces.
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
1898	179,252,000	1903	173,000,000

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.

	£
1899	762,138
1900	970,877
1901	1,010,037
1902	577,533
1903	485,640

The chief mines belong to the Mount Lyell Mining and Railway Company which also possesses reduction works at Queenstown, whence

a railway has been constructed through most difficult country to Teepookana and thence to Strahan. The company has lately amalgamated with the North Lyell Company, and the combined output of the mines during the half-year ended 31st December, 1903, amounted to 178,700 tons of ore, which proved to contain 3,706 tons of copper, 364,288 oz. fine of silver, and 10,280 oz. fine of gold, the total value thereof being £306,683.

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. Only tributors are now at work, but copper to the value of £1,000 was raised in 1903. The proprietors, however, intend to resume operations at an early date. 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 re-opening of a portion of the mine. At present, operations are more or less exploratory in character, but 52 tons of ore were raised on the tribute system. 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 about 1,800 miners are now employed. During 1903 the production from these mines was—Wallaroo 103,656 tons of ore yielding 3,242 tons of copper, and Moonta 61,210 tons of ore yielding 1,785 tons of copper. From the Hamley mines, where 76 men were employed, 4,631 tons of ore were obtained, which yielded 1,066 tons of copper. 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, in 1902 at £432,525, and in 1903 at £472,014.

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, but with a more favourable season it increased to £446,286 in 1903. The chief copper mines are in the western districts, but the production is hampered by lack of a constant water supply. 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 1903 was obtained in the Cobar mining district. The value of the metal raised in the Cobar division of the district amounted to £221,242. 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 £41,150, and the recently developed mines at Crowl's Creek and Shuttleton bid fair to increase the output materially in the near future. In the Burraga division of the Bathurst district one of the leading mines, the Lloyd Copper mine, is situated, and from this mine 1,825 tons of copper, valued at £100,375, were obtained during 1903. 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 370 men, exclusive of wood-cutters, carters, &c., and the mine and works are lighted throughout by electricity. The total number of men engaged in copper-mining during 1903 was 1,816, an increase of 117 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, the decline being chiefly attributable to want of water. In 1903, however, the output exceeded that of any previous year, and amounted to 4,916 tons, valued at £285,122. A noteworthy feature of the revival in 1901 was the re-opening of the Mount Perry mine, which again ranks, as in former years, amongst the foremost mines in the state. The smelting returns of this mine for the year 1903 showed 1,765 tons of copper, valued at £93,103, in addition to silver valued at £7,076, and gold to the value of £5,236. The Herberton district has for many years been the chief copper-producing centre, the output in 1903 being valued at £150,510. In this district the principal mines are those of

the New Chillagoe Railway and Mining Company, which has also leased the Mount Garnet mines for a period of two years. Of the other mines in the district, the Mount Molloy shows the best results, and during the year produced 800 tons of ore averaging 35 per cent. of copper, in addition to 200 tons of a lower grade.

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. There was an increased output in 1903, amounting to 21,531 tons, valued at £56,541. 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 1903 was 193, as against 113 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 £206,895, but the output during the last few years has been very small, the value for 1903 being £500.

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 1903 being only 6 tons, valued at £123.

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 1903 and up to the end of that year is given below :—

State.	Value of Copper produced.	
	During 1903.	To end of year 1903.
	£	£
New South Wales	446,286	6,611,165
Victoria	500	206,895
Queensland	285,122	2,724,014
South Australia	472,014	23,726,585
Western Australia	56,541	391,603
Tasmania	485,640	4,984,668
Commonwealth	1,746,103	38,644,930
New Zealand	123	18,211
Australasia	1,746,226	38,663,141

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, and at the end of that year £56 12s. 6d.

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, and since 1880 no less than 74,637 tons of tin, valued at £6,912,336 have been exported. In 1903 the production amounted to 3,476 tons, valued at £238,883. As in New South Wales, a very large proportion of the metal hitherto produced has been from alluvial deposits. 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 six months ended 31st December, 1903, produced 636 tons of tin, and paid £27,000 in dividends, making a total of £1,912,000 dividends paid to that date. In the Blue Tier district, the Australian and Anchor mines are working on good payable stone, and from the latter mine 116 tons of tin, were obtained during the half-year ended 31st December, 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, produced 216 tons of tin, during the half-year ended 31st December, 1903, while the latter yielded 192 tons of stream tin, and paid dividends amounting to £10,300. Tin dredging has been carried on in some parts of the island; but, so far, only a moderate measure of success has been achieved.

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 Euriowie; 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. A large proportion of the tin obtained is recovered from alluvial deposits, and this may be assigned as the principal reason for the fluctuations in the output, as any scarcity of water diminishes the production by retarding successful washing operations.

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, consequent on a fall in prices and a sustained drought. With the more favourable season of 1903 the production again advanced, and attained a value of £155,723.

Considerable success has attended the efforts to recover tin by dredging, and the yield for 1903 amounted to 244 tons, valued at

£20,100. Of this production, 190 tons, valued at £15,532, were obtained in the Tingha district, chiefly by the Cope's Creek dredges, which saved 150 tons, valued at £12,455; from Wylie Creek, in the Wilson's Downfall district, 50 tons, valued at £4,229 were obtained. The number of persons engaged in mining for tin on the 31st December, 1903 was 2,502, of whom 455 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, some attempt has been made to develop the industry in a manner more worthy of its resources, with the result that in 1903, assisted by a good season, the production reached 3,708 tons, valued at £243,149, being the highest value since 1874. The Herberton district was again the chief centre of production, the output in 1903 being valued at £181,022. The most important mines in this district are situated at Irvinebank and Stannary Hills, and from the Vulcan mine, in the former locality, 6,161 tons of black tin, valued at £205,560, have been obtained since October, 1890. The output of the mine for 1903 was 693 tons, valued at £24,560. From the Stannary Hills mines, 209 tons, valued at £15,848, were obtained during the five months ending December, 1903. 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 output up to the end of the year 1903 was 540 tons of concentrates, valued at £38,013. The number of persons engaged in tin-mining on the 31st December, 1903, was 1,598.

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. The production in 1903 was 817 tons, valued at £55,890; the Greenbushes district contributed 525 tons, valued at £34,362, and the Pilbarra field, in the Marble Bar district, 292 tons, valued at £21,528. 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 1903 the production was only 33 tons, valued at £2 165 and was obtained in connection with gold-dredging.

In South Australia very little tin is produced. Durin 1903 the production was 171 tons of ore, valued at £10,772, obtained in the

Northern Territory of the State. 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. Since 1901 there has been a further improvement, and for the first week of 1903 the quotations were £123 10s. per ton, while at the close of the year they had risen to £129 10s. per ton.

The value of the production of tin in Australasia during 1903, and up to the end of that year, was as given below :—

State.	Value of Tin produced.	
	During 1903.	To end of year 1903.
	£	£
New South Wales	155,723	6,817,122
Victoria	2,165	718,163
Queensland	243,149	5,053,186
South Australia	10,772	49,530
Western Australia	55,890	293,872
Tasmania	238,883	7,758,167
Australasia	706,582	20,690,040

The number of persons engaged in tin-mining in 1903 was as follows:—In New South Wales, 2,502; Tasmania, 1,258; Queensland, 1,598; Western Australia, 294; South Australia, 50.

Iron.

Iron is distributed throughout the Commonwealth, and extensive deposits are known to exist in New South Wales, Queensland, South Australia, Western Australia, and Tasmania. In evidence before the Royal Commission on the Bonus for Manufactures Bill, it was stated that the deposits in New South Wales were estimated by the Government

Geologist to contain 59,317,000 tons of ore. The chief deposits are at Carcoar, where they are estimated to contain 3,100,000 tons, and at Cadia, where the quantity is set down at 39,000,000 tons. The ores in the former locality contain rather a high percentage of phosphorus, while at Cadia the product is impregnated with sulphur and copper.

In Queensland the principal deposits occur in the Northumberland and other islands between Rockhampton and Bowen, at Mount Lucy in the Herberton district, at the Iron Mountain in the Kangaroo Hills, and at Mount Leviathan in the Cloncurry district.

In South Australia large deposits of iron ore are found, the most important being those at the Iron Knob and Iron Monarch mines, situated about 40 miles west of Port Augusta. The ore contents of the Iron Monarch were estimated to be 20,000,000 tons.

The deposits in Western Australia are widely distributed, the most important being those in the watershed of the Murchison River, but owing to their geographical position they are practically valueless.

In Tasmania the chief deposits are on the Blythe River, near Burnie, where they are situated within easy distance of shipping facilities. During 1901 the deposit was tested by tunnelling and found to maintain its size and quality, and it is estimated to contain 17,000,000 tons of ore. Considerable attention has been given to the question of establishing ironworks in New South Wales 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 reason to doubt that one 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. The Commission held meetings in various towns of the Commonwealth, and collected a great deal of valuable evidence regarding the iron deposits in the various states, and the possibility of their successful treatment. In submitting their report the members were unanimously agreed that all the materials necessary for the manufacture of iron from its ores were to be found in Australia, in large quantity and of good quality, but they were evenly divided in opinion as to the desirableness of paying bonuses to private individuals, and it was only by the casting vote of the Chairman that the report was in favour thereof. As to the desirableness of establishing the iron industry there can be no doubt, as each year Australia pays away huge sums for its requirements in this direction. The imports in 1903 were valued at £1,429,996, and in previous years even this amount has been greatly exceeded. The following

table shows the value of the imports of iron and steel for the last five years, and their approximate weights :—

Year.	Bar and Rod Iron, Girders, Plate, and Sheets.		Galvanised, Plate, and Sheet Iron.		Pig and Scrap Iron.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	cwt.	£	cwt.	£	cwt.	£
1899	1,855,895	834,211	916,709	780,279	723,920	127,872
1900	2,223,731	1,176,655	983,399	966,201	985,265	230,245
1901	2,081,423	967,323	905,709	741,795	732,512	140,572
1902	.....	744,007	1,104,701	948,059	766,725	131,015
1903	1,211,437	483,448	886,570	786,413	989,998	160,135

In addition to the above, the imports of iron in its manufactured forms, including nails, pipes, tanks, wire, &c., amounted to about £1,780,000 in 1903, so that the total imports for the year reached over £3,210,000. The re-exports were valued at only £84,000; it follows, therefore, that the iron retained for local use was worth some £3,126,000, and as the tendency of the consumption is to increase with production, the quantity of iron required for home use would certainly become greater if works were established locally. The experience of the United States may be cited in this respect. In 1895 the production of ore was 15,958,000 tons, in 1898 it had increased to 19,434,000 tons, and in 1901 to 28,887,000 tons. The consumption for the same years was 16,480,000, 19.589,000, and 29,789,000 tons respectively, having increased from 0·24 tons per head in 1895 to 0·38 tons in 1901.

The production of iron-ore amounts to between 85 and 90 million tons annually, and probably three-fourths of this is produced by the United States, Germany, the United Kingdom, and Spain.

In 1901 the output of iron-ore and the production of pig-iron in various countries was as follows :—

	Output of Iron Ore. tons.	Production of Pig-iron. tons.
United States	28,887,000	15,878,000
United Kingdom	16,570,000	7,929,000
Germany	16,304,000	7,741,000
Spain	7,780,000	.....
France	4,714,000	2,351,000
Austria-Hungary	3,463,000	1,458,000
Sweden	2,750,000	520,000
Belgium	223,000	752,000
Russia	.....	2,776,000

At present the only works in the Commonwealth for the manufacture of iron from the ore are situated at Eskbank, near Lithgow, in New South Wales, 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. Even at these works 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 in 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 1903 was 6086 tons, valued at £85,790. 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 1903 was 22,120 tons, valued at £15,834, and up to the end of that year 63,478 tons, valued at £49,422, had been raised. A considerable quantity of iron oxide is also raised each year and used for flux, while there is also an export, usually of small dimensions, but amounting in 1903 to 1,193 tons. valued at £1,181.

In Tasmania, notwithstanding the huge deposit of iron ore at the Blythe River, the production has not been great, and in 1903 only 9,320 tons, valued at £3,300, were raised, the greater portion of which was shipped to New South Wales for fluxing purposes.

In Queensland 9,808 tons of ore, valued at £3,852, were raised, chiefly in the Herberton district, for use as a flux in smelting, and in South Australia 33,359 tons were obtained from the deposits at Iron Knob and used in the Broken Hill Proprietary Company's reduction works at Port Pirie.

In Western Australia the only iron raised is for smelting purposes, the production in 1903 being 220 tons, valued at £88.

In New Zealand 17 tons of hematite, valued at £116, were raised in 1902, but there was no production in 1903.

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 1903 was valued at only £135, the total production to the end of the year being £194,910.

In Victoria the production up to the end of 1898 was valued at £177,174, and there was no further output until 1903, when the value was £50, 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 1903 :—

State.	Value.
New South Wales	£194,910
Victoria	177,224
Queensland	35,458
Commonwealth	£407,592
New Zealand	52,462
Australasia	£460,054

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 1903 was valued at £9,537, and in Queensland at £2,523, while the total production for each state up to the end of the year was £75,822 and £67,058 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 1903 was £254, making a total of £1,655 up to the end of that year.

In Queensland the output for 1903, valued at £5,332, 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 1903 was £30,312.

In New Zealand the production in 1903 was 70 tons, valued at £210, making the total raised to the end of that year £60,442. In South Australia there was an export during 1902 of 18 tons, valued at £62, but there is no record of production in 1903

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. The value of the production during 1903 was £1,061, and the total to the end of that year, £15,022. 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, but there was no production in 1903.

In Queensland the lead raised during 1903 amounted to 3,795 tons, valued at £43,639, obtained from mines in the Herberton district, and from South Australia lead to the value of £1,267 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 last-mentioned place the assays of ore yielded 22 per cent. of mercury. Very large and rich deposits have been found on Noggriga Creek, near Yulgilbar, where a mine has been established, and 40 tons of ore raised, which yielded 1,010 lb. of quicksilver. A bonus of £500 is offered by the Mines Department to the person or company first producing 50,000 lb. of quicksilver from cinnabar ores raised within the state. In New Zealand during 1903 the Waitahuna Company carried on prospecting operations, but although indications of the presence of the ore were in evidence work was discontinued through lack of funds.

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 had 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 the production in 1902 dwindled to 55 tons, valued at £1,167. Another rise in prices caused increased attention to be devoted to the industry, and the production during 1903 was 197 tons, valued at £7,870. 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 1903, the value being £2,100.

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. Three distinct processes are being used at the Barrier mines, and one of the companies is devoting all its energies to zinc extraction. At Cockle Creek there

are also two zinc-extracting plants operating on purchased ores. As a consequence of these efforts the export of zinc shows a large increase. From a value of £44,187 in 1900 it had diminished to £10,625 in 1902, but in 1903 no less than 20,754 tons, valued at £86,587, were exported, making a value of £258,335 up to the end of that year. The world's production of spelter in 1903 was 585,000 tons.

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, Victoria, and South Australia, 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. In South Australia the Cooke's Proprietary Company are working their mine, and have opened up large bodies of ore. Small parcels forwarded to Germany for treatment gave satisfactory results. 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 1903, 153 tons, valued at £1,570, 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 are 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 1903 it had declined to £7,342. 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, but there was no production in 1903.

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 1903 amounting to 5,661 tons, valued at £2,827. The fields of lignite in New Zealand are roughly estimated to contain about 500 million tons; the quantity raised annually is increasing, and in 1903 it amounted to 77,372 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 places the probable contents of these coal-fields at 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. One of the earlier Government Geologists 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 1903 expanded to the large figure of 6,354,846 tons, valued at £2,319,660, both the output and value in the latter year being the highest recorded. The total production of the New South Wales mines, from the date of their opening up to the end of 1903, amounted to 109,741,916 tons, valued at £44,021,103.

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, 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 1903 was 98, an increase of one since the previous

year. They gave employment to 13,917 persons, of whom 10,910 were employed under ground, and 3,007 above ground. The average quantity of coal extracted per miner was 582 tons, as against an average of 591 tons in the previous year, and 619 tons in 1901. For the ten years ended 1903, the average quantity of coal extracted per miner was 565 tons, which, at the mean price of coal at the pit's mouth, was equivalent to £180 11s. 0d. Taking all persons employed at the mines, both above and under ground, the average for the ten years would be 452 tons, equivalent to £144 8s. 5d. 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	565	6 5	144 8 5
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 6,354,846 tons in 1903, 2,638,652 tons—or 41·52 per cent.—were used locally. The exports to Australian ports amounted to 1,761,003 tons, or 27·71 per cent., and to ports outside Australia 1,955,191 tons, or 30·77 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 18 cwt. in 1903. 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 1903 to about 430,000 tons.

The progress of the export trade of New South Wales, from 1881 to 1903, is shown in the following table:—

Exported to—	Quantity.			Value.		
	1881.	1891.	1903.	1881.	1891.	1903.
	tons.	tons.	tons.	£	£	£
Australian States	521,025	1,342,055	1,761,003	200,829	664,847	720,957
New Zealand	136,110	168,921	270,470	54,743	90,662	114,819
Fiji	3,243	16,864	50,939	1,410	8,033	22,577
Hong Kong	99,657	59,227	39,680	40,487	31,761	15,095
India and Ceylon	2,700	21,690	57,737	945	12,149	28,340
Straits Settlements	5,690	89,183	66,756	1,886	49,989	31,969
United Kingdom and other British Possessions	7,081	23,690	39,272	2,836	12,411	19,054
Chili	8,017	196,186	499,778	3,243	108,942	266,177
Hawaiian Islands	8,479	.....	172,130	3,345	.....	91,614
Peru	.....	24,835	49,492	.....	13,821	26,858
Philippine Islands	17,969	53,909	228,562	7,174	29,563	113,508
United States	150,002	365,623	303,790	68,172	200,851	162,220
Other foreign countries	69,871	152,185	176,585	32,460	83,601	91,805
Total	1,029,844	2,514,368	3,716,194	417,530	1,306,630	1,704,993

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.	1903.	1881.	1891.	1903.
	tons.	tons.	tons.	£	£	£
Australasian States	6,049	14,277	12,974	5,022	8,488	14,230
United Kingdom	.....	68,871	56,740	.....	76,027	55,111
Fiji and Norfolk Island	21	3,282	9,299	25	2,469	6,752
Hong Kong	.....	.....	65,285	.....	.....	45,035
Pacific Islands, etc.	551	5,234	8,034	563	4,189	7,799
Total	6,621	91,664	152,332	5,610	91,173	128,927

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 1903 was 1,420,193 tons, valued at £762,858. A large proportion is raised from the mines in the Westport district of the Middle Island, which showed an output of 571,306 tons in 1903. The Otago and Greymouth districts produced respectively 307,562 and 198,441 tons. The Government owns two collieries, situated at Port Elizabeth and Seddonville, and the working account of the latter for the year ended 31st March, 1904, shows that a profit of £777 was made on coal-winning, but this was quite insufficient to meet the interest charges, management expenses, &c., the net loss on the year being £882. The Port Elizabeth mine only began to ship coal in May, 1904, but up to the end of June, 5,000 tons had been sent away. From the Seddonville colliery the output during the period from November, 1903, to March, 1904, was 7,190 tons; but

during May and June, the average weekly output was 812 tons, which could be easily doubled if occasion required.

There is a steady increase in the quantity of coal raised in the colony, and a corresponding decrease in the importation. In 1903 there were 178 coal-mines in operation in New Zealand, giving employment to 2,852 men, the average value of the output per man being 498 tons, and the value £267 9s. 7d.

As showing the various kinds of coal found in New Zealand the following figures relating to the production in 1903 will be of interest:—

Bituminous coal	879,891 tons.
Pitch coal	21,116 ,,
Brown coal.....	441,814 ,,
Lignite	77,372 ,,
Total	1,420,193 ,,

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, the latter being the highest value yet recorded. The production was larger in 1903, when it amounted to 507,801 tons, but the value was only £164,798. 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. Of the total production of 507,801 tons during 1903, 403,462 tons were obtained in the Ipswich district, 99,292 tons at Wide Bay, and 4,742 tons in the Clermont district. There were 1,329 men engaged in the industry in 1903.

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 1903 amounted to 51,805 tons, valued at £20,916, the output for the preceding year being 48,863 tons. The two largest collieries are the Mount Nicholas and the Cornwall, which give employment to 127 men.

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 1903 there were 143 men engaged in coal-mining in the state, and the average output per man amounted to 432·2 tons, valued at £146 5s. 4d.

The output of coal in Victoria had been steadily increasing for some years, and in 1902 reached a total of 225,164 tons, valued at £155,850.

In 1903 operations were greatly interfered with by an unfortunate strike which lasted for practically the whole year, so that the output was only 64,200 tons, valued at £40,818. 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, the export from the latter state in 1903 amounting to 997,912 tons. The principal collieries in the state are the Outtrim Howitt, Jumbunna, and the Coal Creek Proprietary, the output from these during 1903 being 20,601, 18,517, and 20,727 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 1903 was 434,773 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. The output for 1903 was not quite so large, amounting to 133,427 tons, valued at £69,128. 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 8,532,000 tons, and the value £3,378,000. The production of each state during the year 1903 was as follows:—

State.	Quantity.	Value.	
		Total.	Proportion raised in each State.
	tons.	£	per cent.
New South Wales	6,354,846	2,319,660	68·67
Victoria	64,200	40,818	1·21
Queensland	507,801	164,798	4·88
Western Australia	133,427	69,128	2·04
Tasmania	51,805	20,916	0·62
Commonwealth	7,112,079	2,615,320	77·42
New Zealand	1,420,193	762,858	22·58
Australasia	8,532,272	3,378,178	100·00

The total quantity and value of the coal produced in Australasia up to the end of 1903 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. tons.	Value. £
New South Wales	109,741,916 tons	44,021,102
Victoria	2,237,257 ,,	1,239,026
Queensland	7,704,855 ,,	3,159,073
Western Australia	568,401 ,,	306,288
Tasmania	900,932 ,,	507,914
Commonwealth	121,153,361 ,,	49,233,403
New Zealand	18,563,403 ,,	9,869,184
Australasia	139,716,764 ,,	£59,102,587

During the year 1903 this industry gave direct employment in and about the mines to the following numbers of persons in the several states :—

	No.
New South Wales	14,117
Victoria	377
Queensland	1,329
South Australia	...
Western Australia	402
Tasmania	143
New Zealand	...

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
Total	8,556

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 1903, the average price obtained has been 8s. 0d. but the mean of the last ten years has not been more than 6s. 5d. In

1903 the average price per ton of coal at the pit's mouth was as follows:—

	s.	d.
New South Wales	7	4
Victoria	12	9
Queensland	6	6
Western Australia	10	4
Tasmania	8	10
Commonwealth	7	4
New Zealand	10	9
Australasia	7	11

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. 8¼d. 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 1903, except those for the United States and Canada, which refer to the year 1902:—

Country.	Tons of 2,240 lb.
United Kingdom	230,334,000
United States	*320,983,000
Germany	114,772,000
Austria	11,314,000
France	33,769,000
Belgium	23,529,000
Canada	6,821,000
Australasia	8,532,000

* 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 1903, the quantity of kerosene shale raised has amounted to 1,171,124 tons, worth £2,058,958. The average price realised during that period has been £1 15s. 2d. per ton. The prices ruling in 1903, when 34,776 tons were extracted, averaged 16s. 6d. per ton, representing a total value of £28,617 for the production of the year.

Extensive formations of oil shale have been found in New Zealand, at Otago, and at Orepuki, in Southland, where a mine was opened and extensive works erected to treat the mineral for the extraction of oils, paraffin wax, ammonia, &c., but the venture was not attended with success. 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	4,812,930	gallons	£139,979
Victoria	4,569,825	,,	120,541
Queensland	2,010,393	,,	78,576
South Australia	1,363,803	,,	35,283
Western Australia	1,590,038	,,	46,694
Tasmania	385,894	,,	15,866
Commonwealth	14,732,883	,,	436,939
New Zealand	3,152,397	,,	117,454
Australasia	17,885,280	,,	554,393

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 1903 was £11,857,270. In the year 1903 the quantity obtained was 9,357 tons representing a value of £631,102, and the industry 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. The principal source of supply is Lake Fowler, and in summer the entire area is covered with a saline deposit. The article is only procurable during the period from November to March, and in 1903-4 there were 400 persons engaged collecting and refining it, and the quantity produced amounted to 40,000 tons, valued at £55,000.

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 1903, 21,871 tons of alunite had been raised in the locality, most of the product having been sent to England for treatment. During 1903 the Bulladelah mine yielded 2,484 tons of stone, valued at £6,212.

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 principal quarries are at Caloola, near Newbridge, where an excellent description of white marble is obtained. As showing the quality of marble available in New South Wales it may be mentioned that it has been used exclusively in the construction of the staircase in the new court of the Sydney Art Gallery. There are four distinct varieties of marble represented therein which were obtained from Caloola, Rockley, Fernbrook and Molong, and the artistic use of these has resulted in a charming and universally admired effect.

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 1903 being 23,579 tons, valued at £17,213. In Western Australia a considerable quantity of limestone is raised for fluxing purposes, the production in 1903 being 1,279 tons, valued at £178. 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 1903 amounted to 13,612 tons, valued at £8,060, the total production up to the end of that year being 28,533 tons, valued at £20,495. In South Australia 40,138 tons of limestone were raised from the deposits at Yorke's Peninsula.

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 1903 being

3,590 tons, valued at £897. 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. In Victoria during 1903, 400 tons of infusorial earth were raised, the value being £2,400. 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 gemstones 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 adamantiferous 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 1903 the value amounted to £9,987, and the total value of the diamonds produced up to the end of that year was £86,604; 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 £816,600 has been sold up to the end of 1903. 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. The production for the year 1902 was valued at £140,000, and in 1903 at £100,000. The number of men engaged in the opal mining industry was 1,115.

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. At Station Creek, in the Paroo district, a deposit of opal, valued at £2,000, was unearthed during 1903. In that year the production was valued at £7,300, and the total up to the end of the year, at £146,145. There are 170 men engaged in this industry.

Other gemstones, including the sapphire, emerald, oriental emerald, ruby, opal, amethyst, garnet, chrysolite, topaz, cairngorm, onyx, zircon, &c., 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 at the sapphire fields of Anakie, in Queensland, there is now a population of 150 persons. 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 season of 1903 was more favourable, the production being valued at £6,500. 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 1903 will be found below :—

State.	Total Value.	Proportion in each State.	Average value per head.
	£	per cent.	£ s. d.
New South Wales	5,912,612	21·60	4 3 1
Victoria	3,381,520	12·35	2 15 11
Queensland	3,686,096	13·47	7 2 2
South Australia	583,926	2·14	1 11 9
Western Australia	8,971,698	32·78	40 10 11
Tasmania	1,302,921	4·76	7 6 9
Commonwealth	23,838,773	87·10	6 1 9
New Zealand	3,530,654	12·90	4 6 1
Australasia	27,369,427	100·00	5 15 6

The total value of the minerals raised in Australasia during 1903 was £27,369,427, being £2,397,420 in excess of the value for 1901, which had hitherto been 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 125,400 The total employment in each branch of mining during 1903 was :—

State.	Number of Persons engaged in Mining for—						Total.
	Gold.	Silver and Lead.	Copper.	Tin.	Coal, Coke, and Shale.	Other Minerals & Precious Stones.	
New South Wales	11,247	6,035	1,816	2,502	14,117	1,842	37,559
Victoria	25,208	.....	.....	.....	377	84	25,669
Queensland	9,229	458	1,418	1,598	1,329	506	14,538
South Australia	2,000	150	4,033	50	50	700	7,033
Western Australia	20,716	....	193	294	402	1	21,606
Tasmania	988	.....	*3,289	1,258	143	.....	5,678
Commonwealth	69,388	6,643	10,790	5,702	16,418	3,133	112,083
New Zealand	10,210	....	.....	.....	2,852	256	13,318
Australasia	79,598	6,643	10,799	5,702	19,270	3,389	125,401

* 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 37,559; the greatest number of gold-miners is in Victoria. The total number of persons in the Commonwealth engaged in mining pursuits is 112,083, 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 1903, as well as he value per inhabitant for the whole of Australasia:—

State.	1871.	1881.	1891.	1901.	1903.
	£	£	£	£	£
New South Wales	1,650,000	2,121,000	6,396,000	5,854,150	5,912,612
Victoria	5,400,000	3,467,000	2,339,000	3,312,162	3,381,520
Queensland	806,000	3,165,000	2,300,000	3,114,702	3,686,096
South Australia	725,000	421,000	366,000	613,930	583,926
Western Australia	5,000	11,000	130,000	7,445,772	8,971,698
Tasmania	25,000	604,000	516,000	1,675,290	1,302,921
Commonwealth	8,611,000	9,789,000	12,047,000	22,016,006	23,838,773
New Zealand	3,100,000	1,528,000	1,841,000	2,956,001	3,530,654
Australasia — Total	11,711,000	11,317,000	13,888,000	24,972,007	27,369,427
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 15 6

The foregoing table shows that the mineral production of 1903 was nearly fourteen and a half 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 £483,000 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 £8,842,000, mainly on account of the great increase in the gold yield, which advanced in value from £115,182 to £8,770,720 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 nearly £1,690,000.

Comparing the value of the mineral production in 1903 with the population, the largest amount is shown by Western Australia, with £40 10s. 11d. per inhabitant; Tasmania ranks second, with £7 6s. 9d. per inhabitant; Queensland third, with £7 2s. 2d.; New Zealand fourth, with £4 6s. 1d.; New South Wales fifth, with £4 3s. 1d. Victoria follows with an average of £2 15s. 11d. per head, and in South Australia the production per inhabitant was only £1 11s. 9d. The average per inhabitant for Australasia was £5 15s. 6d., an increase of 8s. 4d. per head on the figures of the previous year, and the average for the states constituting the Commonwealth was £6 1s. 9d. per head.

The following table shows the value of production in each of the states during 1903, 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 affect seriously 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	1,080,029	1,501,403	446,286	155,723	2,319,660	409,511	5,912,612
Victoria	3,259,483	2,880	500	2,165	40,818	75,674	3,381,520
Queensland	2,839,813	65,538	285,122	243,149	164,798	87,676	3,686,096
South Australia	90,031	2,071	472,014	10,772	.....	9,038	583,926
Western Australia....	8,770,720	19,153	56,541	55,890	69,128	266	8,971,698
Tasmania	254,403	268,526	485,640	238,883	20,916	34,553	1,302,921
Commonwealth ..	16,294,479	1,859,571	1,746,103	706,582	2,615,320	616,718	23,838,773
New Zealand	2,037,831	91,497	123	.....	762,858	*638,345	3,530,654
Australasia	18,332,310	1,951,068	1,746,226	706,582	3,378,178	1,255,063	27,369,427

* Inclusive of kauri gum valued at £631,102.

The total mineral production to the end of 1903 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 ..	50,924,164	35,283,159	6,611,165	6,817,122	44,021,102	5,088,341	148,745,053
Victoria	266,810,712	864,319	206,895	718,163	1,239,026	487,335	270,326,450
Queensland	58,312,127	923,725	2,724,014	5,053,186	3,159,073	450,245	70,622,370
South Australia	2,573,357	140,441	23,726,585	49,530	.....	541,482	27,031,395
Western Australia ..	46,868,094	40,225	391,603	293,872	306,288	418,075	48,318,157
Tasmania	5,449,564	2,872,276	4,984,668	7,758,167	507,914	372,560	21,945,149
Commonwealth ..	430,938,018	40,124,145	38,644,930	20,690,040	49,233,403	*7,358,038	586,988,574
New Zealand	63,149,147	544,278	18,211	.....	9,869,184	12,125,347	85,706,167
Australasia	494,087,165	40,668,423	38,663,141	20,690,040	59,102,587	19,483,385	672,694,741

* Inclusive of kauri gum of the value of £11,857,270.

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 1903, the remainder, £672,414,818, represents the value of mineral production from 1852, equal to an average of £12,647,949 per annum for the fifty-one years.