

## MINERAL RESOURCES.

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

### NOBLE METALS.

*Gold*, the most valuable of noble metals, is found throughout Australasia, and the present prosperity of the colonies 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 gold, 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 Strzlecki 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 and Tasmania; the rush to Canoona, in what is now Queensland, took place in 1858; and gold was also discovered in New Zealand in the same year, though it was not until 1861 that a large population was, by the prospect of rapidly obtaining wealth, attracted to the last-mentioned colony.

In Western Australia gold was first found in 1868, although it was not until 1887 that any diggings of importance were discovered. These

were situated at Yilgarn, about 200 miles east of Perth, and at Southern Cross, a little farther south. In 1892 a sensational discovery of gold was made at Coolgardie, 115 miles east of Southern Cross; and in 1893 another gold-field was found in the Dundas Hills, 130 miles south of Coolgardie, on the track to Esperance Bay. During the past three years these fields have attracted a large number of miners from the eastern colonies, and the rush to Coolgardie at one time almost resembled the rushes of the early gold-digging days. Until quite recently Western Australia was considered to be destitute of mineral deposits of any value, but now it is known that a rich belt of mineral country extends from north to south.

The following table gives the value of gold raised from the commencement of mining in the various colonies to the close of the year 1894, with the proportion due to each province:—

Colony	Production of Gold.	
	Value.	Proportion raised in each Colony.
	£	per cent.
New South Wales .....	41,010,669	11·1
Victoria .....	237,784,090	64·2
Queensland .....	34,744,231	9·4
South Australia .....	1,694,086	0·4
Western Australia .....	2,155,485	0·6
Tasmania .....	2,933,617	0·8
New Zealand .....	50,188,838	13·5
Australasia .....	370,511,016	100·0

It will be readily understood from the foregoing figures how Victoria, although in area the smallest of the group, with the exception of Tasmania, achieved the foremost position amongst the colonies, and retained that place so long as the powerful attraction of gold continued. But although the discovery of such extraordinary deposits as those of Mount Morgan, in Queensland, may astonish the world and give princely dividends to shareholders, the thirst for gold—so powerful in the past—cannot now entice any considerable proportion of the population from other pursuits, and this notwithstanding that only a small portion of the auriferous area of the continent has been explored, and a still smaller portion fully developed.

The production of gold, which had been declining steadily for many years, reached the lowest point in 1886. Since then there has been a marked revival, owing chiefly to the increased production of Queensland. It will be seen from the following figures, showing the quantity and value of gold obtained during the year 1894, that the annual production of Queensland is now almost equal in value to that of

Victoria. The returns from South Australia include 31,544 oz., the production of the Northern Territory :—

Colony.	Weight of Gold.			Value of Gold.	
	Alluvial.	Quartz.	Total.	Total.	Proportion raised in each Colony.
	oz.	oz.	oz.	£	per cent.
New South Wales .....	93,742	231,045	324,787	1,156,717	14.0
Victoria .....	254,309	419,371	673,680	2,694,722	32.6
Queensland .....	25,938	653,573	679,511	2,378,289	28.8
South Australia .....	.....	.....	40,448	142,793	1.7
Western Australia .....	.....	.....	207,131	787,099	9.5
Tasmania .....	7,663	50,396	58,059	225,485	2.7
New Zealand .....	40,172	181,443	221,615	887,839	10.7
Australasia .....	.....	.....	2,205,231	8,272,944	100.0

In 1895, as will be seen below, the production of gold in Australasia was 2,353,811 oz., or an increase of 148,580 oz. on the quantity raised in the previous year. It must be pointed out, however, that in 1895 Victoria abandoned the method of relying solely on the returns of the Mining Registrars for the weight of gold produced during the year, and adopted as a basis for forming an estimate these returns taken in conjunction with the transactions of the Melbourne Mint. This difference in the system of estimation is accountable for 46,890 oz. of the 66,356 oz. by which the production of that colony in 1895 exceeded the output in 1894. It is possible that the figures for some of the preceding years will be afterwards adjusted to the new basis, and at present they must be taken with this qualification :—

Colony.	Weight.	Increase on previous year.	Decrease from previous year.
	oz.	oz.	oz.
New South Wales .....	360,165	35,378	.....
Victoria .....	740,036	66,356	.....
Queensland .....	626,299	.....	53,212
South Australia .....	47,343	6,895	.....
Western Australia .....	231,513	24,382	.....
Tasmania .....	54,964	.....	3,095
New Zealand .....	293,491	71,876	.....
Australasia .....	2,353,811	148,580	.....

The average value of gold won by each miner is given below, but as the conditions under which mining is carried on are by no means the

same in every colony, the figures, which vary considerably, may be somewhat misleading. In those provinces where a revival of mining has lately been experienced it is natural to expect a fall in the average yield per miner, for mining as now carried out is not an industry from which immediate returns can be expected. It is probable that the number of gold-miners in New South Wales is largely overstated, otherwise the industry must be carried on at a great loss. Most likely many of the men employ themselves in mining for only a portion of their time, and devote the rest to more remunerative pursuits. But when full allowance is made on this score it will be evident that in some colonies at least the search for gold is not a profitable occupation. The following table shows the number of miners at work in 1894, with the quantity and value of gold won per man, in those colonies for which such information is available:—

Colony.	Miners Employed.	Average production of Gold.	
		Quantity.	Value.
	No.	oz.	£ s. d.
New South Wales.....	17,207	18'88	67 4 6
Victoria .....	27,889	23'32	93 5 7
Queensland .....	11,428	59'46	208 2 3
Tasmania.....	1,291	44'97	174 13 2
New Zealand .....	11,412	19'42	77 16 0

Attempts have been made to ascertain the average yield from quartz, but the number of tests made and the quantity of stone treated are inconsiderable; furthermore, it has not been found possible to obtain returns from all the principal mining centres. The results obtained for the seven years ended 1894 were as given below. The high average yield for Queensland is due to the Mount Morgan mines, which for some years yielded one-third of the total gold production of that colony. The average yield of New Zealand crushings for the year 1894 is given as 1 oz. 1 dwt. 5 gr:—

Year.	New South Wales.	Victoria.	Queensland.	Tasmania.
	oz. dwt. gr.	oz. dwt. gr.	oz. dwt. gr.	oz. dwt. gr.
1888	1 0 18	0 9 18	1 14 11	1 5 2
1889	1 0 2	0 9 19	1 17 20	0 17 16
1890	0 15 8	0 9 4	1 7 15	0 16 12
1891	0 18 13	0 9 4	1 3 21	1 0 23
1892	0 19 19	0 9 23	1 6 20	0 14 19
1893	0 16 11	0 9 6	1 6 8	0 13 22
1894	0 14 8	0 8 8	1 4 5	1 1 10

It is not pretended that these figures have any great statistical value, but nevertheless they may be accepted as giving an approximate idea of the average yield of quartz-reefs. Alluvial deposits are generally richer than those in reefs; but the precious metal is so unevenly distributed that any attempt to obtain a reliable average would be futile.

The greatest development of quartz-reefing is found in Victoria, some of the mines being of a great depth. The twelve deepest mines at the close of 1894 were as follow:—

	feet.
Lansell's 180 Mine, Bendigo.....	3,122
New Chum Consolidated Company, Bendigo .....	2,905
New Chum and Victoria Company, Bendigo.....	2,800
Lazarus Company, Bendigo .....	2,777
New Chum Railway Company, Bendigo .....	2,662
Shenandoah Company, Bendigo .....	2,639
Carlisle Company, Bendigo .....	2,602
Victoria and Pandora Company, Bendigo .....	2,500
New Chum United Company, Bendigo .....	2,489
Great Extended Hustler's Company, Bendigo .....	2,420
Garibaldi Company, Bendigo .....	2,415
Magdala Company, Stawell .....	2,409

The value of machinery on the gold-fields of those colonies from which returns were obtainable is appended. For Queensland, Tasmania, and New Zealand the figures refer to the year 1894; for Victoria the latest information available is for 1892; while the New South Wales figures are for 1895:—

Colony.	Value.
	£
New South Wales .....	640,697
Victoria .....	1,772,524
Queensland .....	1,090,700
Tasmania .....	396,085
New Zealand .....	395,985

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
One 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 1,182 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 colony. Veins of gold of extraordinary richness have been worked in New South Wales. In January, 1873, at Beyers and Holtermann'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, in the middle of 1894, had paid in dividends £3,500,000. This mine, which may be designated one of the wonders of the world, is a huge mound of ore, highly ferruginous, and contains gold to the extent of several ounces to the ton, the peculiar formation, in the opinion of the Government Geologist of Queensland, being due to the action of thermal springs.

For the ten years ended 1893, the world's production of gold is estimated by the Director of the United States Mint as follows:—

Year.	Value.	Year.	Value.
	£		£
1884	20,340,000	1889	24,699,000
1885	21,680,000	1890	23,780,000
1886	20,120,000	1891	26,130,000
1887	20,155,000	1892	29,260,000
1888	22,139,000	1893	31,110,000

Owing chiefly to the increased production of the South African gold mines, the total value of gold produced in 1894 will probably be found to have reached £38,000,000. Of this amount the Australasian colonies produced about 21·6 per cent.

*Platinum* and *iridosmine*, though not specially sought for by miners, have been found in New South Wales and New Zealand, but few efforts have been made to ascertain whether either mineral can be extracted with satisfactory commercial results. The same remarks apply to the noble metal *tellurium*, which is found in New Zealand, associated with gold and silver (*petzite*) and with silver only (*hessite*).

*Silver* has been discovered in all the colonies, 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 colonies 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 colony, 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 in the Broken Hill and Silverton districts during 1894 was £2,249,128; while the machinery employed was valued at £762,516. The aggregate output of the mines in the Barrier country to the end of the year named was valued at £17,790,587. This rich silver-field, which was discovered in 1883 by Charles Rasp, a boundary rider on Mount Gipps Run, extends over 2,500 square miles of country, and has developed into one of the principal mining centres of the world. It is situated beyond the river Darling, and close to the boundary between New South Wales and South Australia. In the Barrier Range district the lodes occur in Silurian metamorphic micaceous schists, intruded by granite, porphyry, and diorite, and traversed by numerous quartz reefs, some of which are gold bearing. The Broken Hill lode is the largest as yet discovered. It varies in width from 10 feet to 200 feet, and may be traced for several miles, the country having been taken up all along the line of the lode, and subdivided into numerous leases, held by mining companies and syndicates.

The Broken Hill Proprietary Company hold the premier position. They have erected on their lease a complete smelting plant on the latest and most approved principles, and have enlisted the services of competent managers whose experience has been gained in the celebrated silver-mining centres of the United States. From the commencement of mining operations in 1885 to the beginning of December, 1894, the company treated 2,144,026 tons of silver and silver-lead ores, producing 65,382,472 oz. of silver, and 258,538 tons of lead, valued in the London market at £13,087,041. They have paid dividends to the amount of £5,224,000, and bonuses amounting to £616,000, besides the nominal value of shares from the several "Blocks" sold to other companies, amounting to about £1,744,000, or a total return from the mine of £7,584,000. The sum spent in the erection and construction of plant

from the opening of the property is £642,096. The number of men employed during 1894 was 3,352, of whom 998 were working underground and 458 on the surface; 647 were engaged in quarrying, etc., and 738 in smelting; while 511 were employed in miscellaneous occupations. The net profit for the year 1894 was £740,595. The nominal value of this mine had declined to £2,508,000 in February, 1896, as against £6,500,000 at the end of 1890.

The quantity and value of silver and silver-lead ore exported to the end of 1895 from New South Wales is shown in the following table:—

Year.	Silver.		Silver-Lead.			Total Value.
	Quantity.	Value.	Quantity.		Value.	
			Ore.	Metal.		
Up to	oz.	£	tons cwt.	tons cwt.	£	£
1882	765,397	187,429	203 12	.....	5,385	192,814
1883	77,066	16,488	105 17	.....	1,625	18,113
1884	93,660	19,780	4,668 1	.....	123,174	142,954
1885	794,174	159,187	2,095 16	190 8	107,626	266,813
1886	1,015,434	197,544	4,802 2	.....	294,485	492,029
1887	177,308	32,458	12,530 3	.....	541,952	573,410
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 0	1,560,813	1,642,671
Total	7,220,737	1,292,838	836,583 16	326,040 0	19,331,757	20,624,595

This amount was approximately made up of 99,641,700 ounces of silver, valued at £16,185,480, and of 357,400 tons of lead, valued at £4,439,115. 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, labour disputes and a heavy fall in the price of the metal have considerably reduced the value of the output. The number of miners engaged in silver and lead mines in 1894 was 4,208, and the average value of mineral won by each miner engaged amounted to £544 ls. 7d., as compared with £643 16s. 3d. in 1893, £420 15s. 2d. in 1892, and £473 9s. 2d. in 1891.

Although indications of silver abound in all the other colonies, no fields of great importance have yet been discovered. The value of the yield of Australasia to the end of 1894, exclusive of that of New South Wales, was only £2,303,103.



The leading silver-mines of Queensland are south-west of Cairns, in the Herberton district, and it is from these fields that the largest proportion of the total production of that colony was raised.

In New Zealand silver is found in various localities, principally on the Te Aroha, Thames, and Coromandel fields, but the metal is generally sought in conjunction with gold-mining. The production of the colony during the year 1894 was 54,177 ounces, valued at £6,697.

The silver-mining industry in Tasmania is steadily developing, principally in the Mount Zeehan and Dundas districts, from which almost the whole quantity produced in the colony is obtained. In the first-named district argentiferous lead ore has been found over 30 square miles of country, and the Mount Dundas field, almost adjoining, extends north as far as the Pieman River.

There are no silver-mines in Victoria or Western Australia, the small amount of silver produced by the former colony being found associated with gold. The quantity of silver extracted from gold during 1894 at the Melbourne Branch of the Royal Mint was 50,909 ounces.

The production of silver in South Australia is very limited, and it is remarkable that the argentiferous lead-ore fields of Broken Hill and Silverton, which are almost on the border of the two colonies, are exclusively confined within the boundaries of New South Wales.

Up to the end of 1894 New South Wales had produced over 89 per cent. of the total value of silver raised in Australasia; Victoria came second, with 3·8 per cent.; and the remaining small proportion was distributed over the other colonies, Tasmania claiming the largest share. The total production of silver in Australasia in 1894, and up to the end of that year, was as follows:—

Colony.	During 1894.		To end of year 1894.	
	Value.	Proportion raised in each Colony.	Value.	Proportion raised in each Colony.
	£	per cent.	£	per cent.
New South Wales ...	2,289,489	87·5	18,981,924	89·2
Victoria .....	6,253	0·2	813,223	3·8
Queensland .....	22,077	0·8	599,511	2·8
South Australia .....	.....	.....	101,727	0·5
Western Australia ...	.....	.....	250	0·0
Tasmania .....	293,043	11·2	628,808	3·0
New Zealand .....	6,697	0·3	160,584	0·7
Australasia .....	2,617,559	100·0	21,286,027	100·0

While the quantity of silver produced has increased largely during the last few years, the value of the production shows a decrease, owing to the continued fall in the price of the metal.

The world's production of silver during the ten years ending with 1893 has been estimated by the Director of the United States Mint to be as follows:—

Year.	Ounces.	Year.	Ounces.
1884	81,597,000	1889	120,214,000
1885	91,652,000	1890	126,095,000
1886	93,276,000	1891	137,171,000
1887	96,124,000	1892	152,940,000
1888	108,827,000	1893	162,162,000

The annual output of the colony of New South Wales alone is therefore about one-tenth of the total production of silver.

#### METALLIC MINERALS.

*Lead* is found in each of the Australasian colonies, but is worked only when associated with silver. In Western Australia the lead occurs in the form of sulphides and carbonates of great richness, but the quantity of silver mixed with it is very small. The lodes are most frequently of great size, containing huge masses of galena, and contain so little gangue that the ore can be very easily dressed to 83 or 84 per cent. The Government having offered £10,000 for the first 10,000 tons of lead smelted in the colony, works were erected for this purpose, but the operations of the company were not successful, and the works were closed. Since 1845 Western Australia has exported 34,155 tons of lead ore, valued at about £169,400. The chief mining centres for this mineral are in the Northampton district, between Geraldton and Murchison.

*Mercury*, in the form of sulphides or cinnabar, is found in New South Wales, Queensland, and New Zealand. Few attempts, however, have been made to ascertain whether the deposits are of sufficient value to warrant the expenditure of capital in this direction.

*Copper* is known to exist in all the colonies, but it has been mined for most extensively in South Australia, New South Wales, and Queensland. 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 Kapunda mine, opened up in 1842, was the oldest copper-mine in South Australia. It is estimated that at one time 2,000 tons were produced annually, but the mine was closed in 1879. In 1845 the celebrated Burra Burra mine was discovered. This mine proved to be very rich, and paid nearly £800,000 in dividends to the original owners. For a number of years, however, the mine has been suffered to remain unworked, partly in consequence of the low price of copper, but principally because the deposits originally worked were found to be depleted. 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. During the twenty-nine and a half years over 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. The Wallaroo and Moonta mines were discovered in 1860 and 1861. The latter at one time employed upwards of 1,600 hands, and in 1891 fully 1,100 men; but shortly after that date the industrial operations were disturbed by labour and other difficulties, which were only terminated during the opening month of 1892. In December, 1894, there were 1,904 men employed in the various mines near Wallaroo and Moonta. The output during that year was as follows:—Moonta, 13,989 tons of copper ore, yielding 2,931 tons of fine copper; and Wallaroo, 12,457 tons of copper ore, yielding 1,773 tons of fine copper.

The principal mines in New South Wales are those of Cobar and Nymagee, situated in the centre of the colony, and within 80 miles of each other. The former at one time employed over 500 men and boys; the deepest shaft is 566 feet, and the width of the lode from 2 to 50 feet. From the date of the commencement of operations in 1876 to 1892 the company treated 213,182 tons of ore, giving a return equal to 23,611 tons of refined metal—an average production of 11·07 per cent. of copper per ton of ore; while the sum of £154,000 was paid in dividends to the shareholders. After lying idle for some time, the mine is now being worked on tribute, the production in 1894 being 13,460 tons of ore, equivalent to 665 tons of copper. The number of men employed is 250. Nymagee employed during 1894 a complement of 120 persons. The ores of this mine contain an average proportion of copper equal to 11·42 per cent. Its yield in 1891 was 9,355 tons of sulphide ore, which when melted produced 901 tons of copper, valued at £45,050. The production for 1892 was returned as 6,238 tons of ore, valued at £31,360. The mine was closed during 1893, but was reopened in 1894, and produced 1,688 tons of ore, yielding 149 tons of copper. The refined Nymagee copper is superior to that of Cobar, and commands a higher price in the market. A depth of 734 feet has been reached in sinking through the lode, which varies from 8 to 20 feet. The New Mount Hope and the Great Central copper-mines are also said to be rich in payable ores. The first-mentioned employed 36 men in 1894, and produced copper to the value of £4,054. The South Mount Hope Mine produced copper valued at £4,000. The Burranga Mine during 1889 yielded 476 tons of copper, valued at £36,625; and during 1890, 420 tons, worth £24,150. Owing to the low price of copper this mine was closed during 1891, although the furnaces were kept at work upon 2,000 tons of ore at grass. The deepest shaft is 300 feet, and the lode is said to be 15 feet wide. The output for 1892 was only 800 tons of ore. The mine lay idle until November, 1893, when work was again commenced with 150 men, and copper of the value of £1,800 produced to the end of the year. In 1894, 622 tons of copper were

produced, valued at £24,880. The production of other copper-mines in New South Wales was small; but it may be mentioned here that the Broken Hill Proprietary Company saved 714 tons of copper in their smelting operations.

Cupriferous deposits abound in Queensland, and at one time there was considerable speculation in copper-mining stock of that colony. Peak Downs and Mount Perry acquired great celebrity in the Australian mining market, but afterwards suffered reactionary depression, and were ultimately abandoned—the result, in a large measure, of over-speculation. In Northern Queensland copper is found throughout the Cloncurry district, in the upper basin of the Star River, and the Herberton district. The returns from the copper-fields in the colony are at present small, owing to the lack of suitable fuel for smelting purposes, which renders the economic treatment of the ore difficult; and the development of the mines is greatly retarded by the want of easy and cheaper communication with the coast; but it is expected that these disabilities will be overcome at no distant date, and a revival of the industry is hoped for, as some of the abandoned fields contain very extensive deposits of copper-ore. The total production of copper in Queensland during 1894 was valued at £9,582.

In Western Australia copper deposits have been worked for some years. Very rich lodes of the metal have been found in the Northampton, Murchison, and Champion Bay districts, and also in the country to the south of these districts on the Irwin River. The copper industry, however, is at a standstill at present, on account of the low price of the metal and the heavy expense of cartage, but it is anticipated that the cost of carriage will be reduced, and then several of the mines may be worked at a profit. The total export of copper ore from 1845 to the close of 1894 was 9,138 tons, valued at £153,764.

Copper-mining has not attained any great proportions in Victoria, although deposits have been found in several parts of the colony, particularly in the Beechworth district, where they have been traced over an area of some 50 square miles. The production during 1894 was 485 tons of ore, valued at £14,762, and to the end of 1894, 17,438 tons, valued at £206,185. The copper deposits of New Zealand and Tasmania have been worked to a small extent only.

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 the colonies, but also in Europe and America. Copper sulphides and arsenides of copper are generally found in deep sinkings. The metal has also been found associated with tin in the form of *stannine*.

The number of men employed in copper-mining in New South Wales during 1891 was 481; during 1892, 500; during 1893, 283; and during 1894, 645; whilst only a few hands were employed in the other colonies except South Australia, where the number must have amounted to fully 2,000 in 1894.

The total value of copper produced in Australasia during and up to the end of 1894, and the proportion furnished by each colony, are given below. The value of copper produced in New South Wales during 1895 was £136,969:—

Colony.	During 1894.		To end of year 1894.	
	Value.	Proportion raised in each Colony.	Value.	Proportion raised in each Colony.
	£	per cent.	£	per cent.
New South Wales .....	63,617	20·9	3,733,386	13·9
Victoria .....	14,762	4·9	206,185	0·8
Queensland .....	9,582	3·2	1,973,977	7·3
South Australia .....	210,602	69·4	20,587,669	76·7
Western Australia .....	.....	.....	153,764	0·6
Tasmania .....	5,000	1·6	156,890	0·6
New Zealand .....	.....	.....	17,866	0·1
Australasia .....	303,563	100·0	26,829,737	100·0

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 January, 1893, the quotation had fallen to £46 per ton, and in June and July, 1894, to £41 10s. In December, 1894, prices had recovered a little, and the metal was quoted at £43 10s.

*Tin* was known to exist in Australasia almost from the first years of colonisation, the earliest mention of the mineral 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 colonies, but the richest deposits have been found in Tasmania—the Mount Bischoff being the most celebrated tin-mine in Australasia. The wealth of Queensland and the Northern Territory of South Australia in this mineral, according to the reports of Mr. Jack, the Government Geologist of the former colony, and the late Rev. Tenison Woods, appears to be very great.

In New South Wales tin occurs principally in the granite and basaltic country in the extreme north of the colony, near Tenterfield and Vegetable Creek (now called Emmaville), Tingha, and in other districts of New England. It has also been discovered in the Barrier Ranges, at Poolamacca; near Bombala in the Monaro district, and in

the Valley of the Lachlan, but none of these deposits have as yet been utilised to any extent. The deposits occur in the shape of stream and lode tin, and are worked by European and Chinese miners. Although the mineral was discovered by the Rev. W. B. Clarke as far back as the year 1853, the opening of the tin-fields of New South Wales only took place in the year 1872, but since that date the output from the mines has been considerable. The chief tin-mining centres are at Emma-ville and Tingha, in the northern portion of the colony. Until lately the production of these fields has been from alluvial deposits, which are now said to be practically exhausted.

In Tasmania, as in New South Wales, most of the tin hitherto produced has been from alluvial deposits, while the lodes in the vicinity of Mount Heemskirk, Mount Bischoff, and Ben Lomond have been comparatively neglected. Considerable areas of alluvial tin ground in the eastern and north-eastern divisions are not now yielding their former quantity of ore, and the miners are obliged to turn their attention to the development of the other branch of tin-mining. A thorough test with efficient appliances will shortly be made in the Blue Tier district, where there are deposits containing a payable percentage of tin. The Mount Bischoff Mine and the Ringarooma mines in the north-eastern and north-western divisions respectively yield more than three-fourths of the annual tin production of Tasmania.

The most important tin-mines in Queensland are in the Herberton district, south-west of Cairns; at Cooktown, on the Annan and Bloomfield Rivers; and at Stanthorpe, on the borders of New South Wales. The Herberton is the chief tin-mining centre of Queensland, and the output for 1894 was valued at £67,300. The tin in this district is chiefly obtained from lodes. Herberton and Stanthorpe have produced more than three-fourths of the total production of Queensland to the end of 1894.

The yield of tin in Victoria is very small, and until lately no fields of importance had been discovered, but towards the latter end of 1890 extensive deposits were reported to exist in the Gippsland district at Omeo and Tarwin. The total yield during 1894 was 60 tons, valued at £2,286, and principally obtained at Eldorado and Koetong, where 22 miners were employed.

In South Australia and Western Australia tin-mining is unimportant, the yields up to date being slight, while in New Zealand no production is officially recorded. During 1890 some small fields were reported to have been found in Stewart Island, but there is no record that they have been worked since then. During 1894, 32 tons of tin ore, valued at £1,251, were exported from Port Darwin.

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; from that period until 1893 it fluctuated between £95 and £83; while in 1894 the maximum price was £71 and the minimum price £67.

The value of the production of tin during 1894, and up to the end of that year, was as given below. During 1895 tin to the value of £87,937 was produced in New South Wales:—

Colony.	During 1894.		To end of year 1894.	
	Value.	Proportion raised in each Colony.	Value.	Proportion raised in each Colony.
	£	per cent.	£	per cent.
New South Wales.....	85,264	23·5	6,040,035	35·3
Victoria .....	2,286	0·6	684,606	4·0
Queensland .....	102,277	28·2	4,257,638	24·9
South Australia.....	1,251	0·3	23,667	0·1
Western Australia .....	15,274	4·2	56,151	0·3
Tasmania .....	156,865	43·2	6,060,762	35·4
Australasia .....	363,217	100·0	17,122,859	100·0

The number of persons engaged in tin-mining in 1894 was as follows:—In New South Wales, 1,542; Tasmania, 1,441; Queensland, 998; and Victoria, 22.

*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 some of the colonies, notably in New South Wales, Victoria, Queensland, and New Zealand. Queensland in 1894 produced 68 tons, valued at £1,314. Scheelite, another variety of tungsten, is also found in the last-mentioned colony. *Molybdenum*, in the form of molybdenite (sulphide of molybdenum), is found in New South Wales and Victoria, associated in the former colony with tin or bismuth in quartz-reefs. None of these minerals—titanium, tungsten, and molybdenum—has been systematically mined for.

*Zinc* ores, in the several varieties of carbonates, silicates, oxide, sulphide, and sulphate of zinc, have been found in several of the Australasian colonies, but have attracted little attention.

*Iron* is distributed throughout Australasia, but for want of capital in developing the fields this industry has not progressed. In New South Wales there are, together with coal and limestone in unlimited supply, important deposits of rich iron-ores suitable for smelting purposes; and for the manufacture of steel of certain descriptions abundance of manganese, chrome, and tungsten ores are available. The most extensive fields are in the Mittagong, Wallerawang, and Rylstone districts, which are roughly estimated to contain in the aggregate 12,944,000 tons of ore, containing 5,853,000 tons of metallic iron.

The only works for the manufacture of iron from the ore are situated at Eskbank, near Lithgow, where the metal treated is red siliceous ore, averaging 22 per cent., and brown hematite, yielding 50 per cent. metallic iron. Abundance of coal and limestone are found in the neighbourhood. This establishment, however, has for some time abandoned the manufacture of pig-iron, for which it was originally built. The principal work now carried on is the re-rolling of old rails, and the manufacture of iron bars, rods, and nails, and of ordinary castings. During 1893 the Parliament of New South Wales agreed to a resolution for the manufacture of 30,000 tons of iron pipes in the colony, and portions of the work have since then been let by tender, as opportunity offered. Tenders have recently been called by the Government for the supply of 150,000 tons of steel rails, with the necessary quantities of fish-plates, fish-bolts, and spikes, to be manufactured in New South Wales out of iron ore and other necessary minerals produced in the colony. The tenders will close on the 30th December, 1896, and the specification provides for the delivery of 15,000 tons per annum, in equal monthly quantities; the first delivery to take place not later than eighteen months after the beginning of the contract.

*Magnetite*, or magnetic iron, the richest of all iron ores, is found in abundance near Wallerawang in New South Wales. The proximity of coal-beds now being worked should accelerate the development of the iron deposits, which contain 41 per cent. of metal. *Magnetite* occurs in great abundance in Western Australia, together with hematite, which would be of enormous value if cheap labour were abundant.

Works for the treatment of local titaniferous iron ore were erected some years ago at Taranaki, on the west coast of New Zealand, but it was found that the cost of smelting left no margin for profit, and the works were consequently abandoned.

*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.

Sulphuretted iron ores (*pyrites*) are of little intrinsic value, but are frequently of considerable worth on account of the other minerals with which they are associated, common pyrites being often auriferous. *Mispickel* differs from other pyrites inasmuch as it contains arsenic, and sometimes gold and silver, and is frequently associated with tin and copper ores; but the extraction of gold is rendered difficult on account of the presence of the arsenic. These minerals (*pyrites*) are common to all the colonies.



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

*Cobalt* occurs in New South Wales and Victoria, and efforts have been made in the former colony to treat the ore, the metal having a high commercial value; but the results have not been of an encouraging nature, and the development of this industry is in abeyance. The manganese ores of the Bathurst district often contain a small percentage of cobalt—sufficient, indeed, to warrant further attempts in this direction.

*Manganese* probably exists in all the colonies, deposits having been found in New South Wales, Victoria, Queensland, New Zealand, and Western Australia, the richest specimens being obtained in New South Wales and New Zealand. Little, however, has been done to utilise the deposits, the demands of the colonial 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, plentiful as it is in that colony, 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 of manganese in New Zealand during 1894 was valued at £1,156, and the total yield up to the end of that year, £57,263. New South Wales is the only other colony producing even a small quantity of this mineral—in 1894, 13½ tons, valued at £44; and in 1895, 3½ tons, valued at £10.

*Chrome Iron* or chrome ore has been found in New Zealand and Tasmania, but the only attempt to work this mineral in this part of the world is that made at New Caledonia.

*Sulphur* exists in large quantities in the volcanic regions of New Zealand, where it will doubtless some day become an article of commerce. Professor Liversidge, in his work on the minerals of New South Wales, states that sulphur occurs in small quantities at Mount Wingen, in the Upper Hunter district of that colony, and also 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.

*Antimony* is widely diffused throughout Australasia, and is sometimes found associated with gold. Extensive fields have been discovered in the northern table-lands of New South Wales, especially at Hillgrove, in the vicinity of Uralla. In Victoria the production for the last few years has been small in comparison with that of former periods; only 25 men were engaged mining for this metal during 1894, as against 238 in 1890. The fluctuation in the price of the mineral in the London

market is the cause of this great falling-off in the industry. In Queensland the fields were all showing development in 1891, when the output exhibited a very large increase compared with that of former years, but since then the production has fallen off to a considerable extent. In New Zealand very little antimony ore was obtained during the year 1894, the quantity exported from that colony being only 44 tons, valued at £761. Good lodes of *stibnite* (sulphide of antimony) have been found near Roebourne, in Western Australia.

The following table shows the value of antimony produced in Australasia up to the end of 1894 :—

Colony.	Value.	Proportion raised in each colony.
	£	per cent.
New South Wales .....	174,314	40·0
Victoria .....	176,644	40·5
Queensland .....	34,958	8·0
New Zealand .....	50,268	11·5
Australasia .....	436,184	100·0

The antimony produced by New South Wales in 1894 was valued at £18,744; that produced by New Zealand was worth £761; by Queensland, £280; and by Victoria, £175. In 1895 New South Wales produced antimony to the value of £7,251.

*Bismuth* is known to exist in all the Australian colonies, but up to the present time it has been mined for in New South Wales and Queensland only. It is usually found in association with tin and other minerals, but in one instance a mass of native bismuth, weighing 30 lb., was found in New South Wales. The principal mine is situated at Kingsgate, in the New England district, where the mineral is generally associated with molybdenum and gold; this mine, however, is at present closed. The value of bismuth produced up to the end of 1894 in New South Wales and Queensland was £37,722 and £54,277 respectively. The value of bismuth produced during 1894 in Queensland was £6,270. No production of bismuth is reported for New South Wales since 1892.

#### 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 colonies except

New South Wales, where in 1889 a lode 6 feet wide was discovered near Undercliff, in the New England district; and in Western Australia, in which colony, however, owing principally to difficulties of transit, very little of it has been worked.

The Australasian colonies have 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 the colonies of New Zealand and Victoria. Attempts have frequently been made to use the mineral for ordinary fuel purposes, but its inferior quality has prevented its general use. In Victoria, during 1894, 3,515 tons were raised, valued at £2,008. The fields of lignite in New Zealand are roughly estimated to contain about 500 million tons. Their production is included with that of black coal.

*Black coal* forms one of the principal mineral resources of New South Wales, and in New Zealand the rich deposits of this valuable substance are rapidly being developed. That they will form an important source of commercial prosperity cannot be doubted, as the known areas of the coal-fields of this class have been roughly estimated to contain about 500 million tons of coal in New Zealand, and 78,198 million tons in New South Wales. New Zealand also possesses a superior quality of bituminous coal, which is found on the west coast of the Middle Island. An estimate of the probable contents of these coal-fields is given as 200 million tons. Coal has been discovered in Victoria, and raised in small quantities for some years past, the production of the year 1892 being 23,363 tons, valued at £20,044; of 1893, 91,726 tons, valued at £49,167; and of 1894, 171,660 tons, valued at £94,999. Excellent steam coal has been found in Tasmania, and coal-mining in that colony is becoming a well established industry. From time to time reports have been raised of the discovery of coal in South Australia, but no very definite or satisfactory information on the subject has been brought forward, such as would warrant the employment of capital, except in the direction of prospecting researches. For 1894 a production of 19 tons, valued at £11, is reported. 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 colony extends from the Irwin northwards to the Gascoyne River, about 300 miles distant, and probably all the way to the Kimberley district. Brown coal, of a somewhat poor quality, has been discovered on the south-eastern coast of the colony, but black coal of fairly good quality has been

found on the Fly Brook, near Cape Leeuwin, and in the bed of the Collie River, near Bunbury, to the south of Perth. The Government are now constructing a line of railway to the Collie coal-field. Mr. Jack, the Government Geologist of Queensland, considers the extent of the coal-fields of that colony to be practically unlimited, and is of opinion 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. Coal-mining has been an established industry in Queensland for some years, and is progressing satisfactorily.

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's Strait. 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 under the monopoly of the Australian Agricultural Company, the quantity raised had in 1891 expanded to the large figure of 4,037,929 tons, valued at £1,742,796. In 1892, however, the output was only 3,780,968 tons, valued at £1,462,388; and in 1893 there was a further decrease to 3,278,328 tons, valued at £1,171,722. In 1894 the output increased to 3,672,076 tons, but owing to the fall in the price of coal the value of this production was only £1,155,573. The output for 1895 was 3,738,589 tons, valued at £1,095,327.

The coal-fields of New South Wales are situated in three distinct regions—the Northern, Southern, and Western districts. The first of these comprises chiefly the mines of the Hunter River districts; 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.

The number of coal-mines registered in New South Wales during 1894 was 91, as compared with 97 in the previous year. They gave

employment to 9,348 persons, of whom 7,586 were employed under ground, and 1,762 above ground. The average quantity of coal extracted per miner was 402 tons, as against an average of 327 tons in the previous year, and 360 tons in 1892. In 1885 the weight per miner stood at 405 tons, but the yield gradually declined until the average for 1890 was only 290 tons, owing to the collieries standing idle for several months during the year on account of the general strike. Since that year a gradual recovery has taken place, and the average for 1894, as shown above, was nearly as high as that for 1885. The average quantity of coal extracted per miner, calculated upon the basis of the output for the ten years ended 1894, was 356 tons, which, at the mean price of coal at the pit's mouth, was equivalent to £148 6s. 8d. 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 given by Mulhall :—

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 (1885-94)...	356	8 4	148 6 8
Great Britain .....	330	6 0	111 0 0
United States .....	347	8 4	139 0 0
Germany .....	336	5 3	78 0 0
France .....	196	9 0	88 0 0
Belgium .....	168	7 6	63 0 0
Austria .....	270	5 0	57 0 0

New South Wales was its own chief customer during the last three years. In 1891, out of a total production of 4,037,929 tons, the consumption amounted to 1,523,561 tons, or nearly 38 per cent. The colony of Victoria took the next largest share of the output, viz., 954,277 tons, or 38 per cent. of a total export of 2,514,368 tons. In 1894, when the total production amounted to 3,672,076 tons, the home consumption was 1,546,951 tons, or over 42 per cent. Victoria took 705,343 tons, or 33 per cent. of a total export of 2,125,125 tons.

The quantity of coal required for local consumption shows a satisfactory increase during most years. The annual consumption per head increased from 16 cwt. in 1877 to 25 cwt. in 1894. The larger use of steam for railway locomotives and for manufacturing and other purposes, as well as the multiplication of gas-works, accounts for a great portion of the increase; but it must also be borne in mind that there is a large and growing demand for bunker coal for ocean-going steamers, which appears not as an export, but as required for home consumption. The amount of coal taken by the steamers during 1894 was little short of 300,000 tons.

The progress of the export trade of New South Wales, from 1881 to 1894, is shown in the following table:—

Exported to—	Quantity.			Value.		
	1881.	1891.	1894.	1881.	1891.	1894.
	tons.	tons.	tons.	£	£	£
Australasian colonies .....	657,135	1,510,976	1,171,842	255,572	755,509	418,654
India, Ceylon, and China .....	136,511	188,000	96,065	59,944	105,208	39,139
Mauritius .....	6,249	19,760	12,746	2,414	10,813	5,014
Pacific Islands .....	19,526	141,055	168,632	8,011	75,893	68,030
United States .....	160,002	365,623	277,575	68,172	200,851	112,271
South America .....	8,017	221,700	314,836	3,243	123,136	127,232
Other countries .....	52,404	67,254	83,429	20,174	35,310	34,429
Total .....	1,029,844	2,514,368	2,125,125	417,530	1,306,630	804,769

New Zealand is the only other colony in a position to export coal to any large extent. Its export trade in 1881, 1891, and 1894 was as follows:—

Exported to—	Quantity.			Value.		
	1881.	1891.	1894.	1881.	1891.	1894.
	tons.	tons.	tons.	£	£	£
Australasian colonies .....	6,049	14,277	4,360	5,022	8,488	4,347
United Kingdom .....	.....	68,871	54,047	.....	76,027	56,046
Fiji and Norfolk Island ...	21	3,282	7,909	25	2,469	4,927
Pacific Islands, etc. ....	551	5,234	8,688	563	4,189	8,118
Total .....	6,621	91,664	75,004	5,610	91,173	73,438

The exports to the United Kingdom from New Zealand, as well as from New South Wales, consisted entirely of bunker coal for the steamers. Most of the coal-beds of the former colony are on the West coast of the South Island. The chief mines are at Westport, Grey-mouth, and Otago. The total quantity of coal produced in 1894 was 719,546 tons, of which the Westport colliery contributed 215,770 tons, the Brunner collieries 121,185 tons, and the Kaitangata mines in Otago 67,091 tons. As showing the various kinds of coal found in New Zealand the following figures relating to the production in 1894 will be of interest:—

Bituminous coal .....	418,589 tons.
Pitch coal .....	102,389 "
Brown coal .....	170,815 "
Lignite .....	27,753 "
Total .....	719,546 "

The total production of coal in Queensland during 1894 was 270,705 tons, valued at £114,593, most of which came from the mines at Ipswich, and at Burrum, in the Maryborough district. In 1881 the colony exported 2,742 tons, valued at £1,783; in 1891, 9,635 tons, valued at £9,043; and in 1894, 1,367 tons, valued at £1,752. While Victoria in 1892 produced but 23,363 tons, valued at £20,044, the output in 1894 was 171,660 tons, valued at £94,999. Tasmania produced, during 1894, 30,922 tons, valued at £13,184. As already stated, a production of 19 tons of coal, valued at £11, is reported for the year 1894 in South Australia.

The quantity of coal extracted annually in Australasia averages over 4,800,000 tons, valued at about £1,800,000. The production of each colony during the year 1894 was as follows:—

Colony.	Quantity.	Value.	
		Total.	Proportion raised in each Colony.
	tons.	£	per cent.
New South Wales .....	3,672,076	1,155,573	65·1
Victoria .....	171,660	94,999	5·4
Queensland .....	270,705	114,593	6·5
South Australia .....	19	11	0·0
Tasmania .....	30,922	13,184	0·7
New Zealand .....	719,546	395,709	22·3
Australasia .....	4,864,928	1,774,069	100·0

The total quantity and value of the coal produced in the Australasian colonies up to the end of 1894 are shown in the following table:—

Colony.	Quantity.	Value.	
		Total.	Proportion raised in each Colony.
	tons.	£	per cent.
New South Wales .....	64,634,160	29,598,724	80·6
Victoria .....	364,663	236,895	0·7
Queensland .....	3,701,111	1,704,793	4·6
South Australia .....	19	11	0·0
Tasmania .....	492,536	300,530	0·8
New Zealand .....	9,216,395	4,897,999	13·3
Australasia .....	78,408,884	36,738,952	100·0

During the year 1894 this industry gave direct employment in and about the mines to the following numbers of persons in the several colonies for which returns are available :—

	Miners.
New South Wales .....	9,348
Victoria .....	734
Queensland .....	910
Tasmania .....	128
New Zealand .....	1,899

The average price of coal per ton varies in the colonies very considerably. In New South Wales, during the 47 years which have elapsed since 1847, the year when the Australian Agricultural Company's monopoly ceased, the average price obtained has been 9s. 2d., but the mean of the last ten years has not been more than 8s. 4d. In 1894 the average price per ton of coal at the pit's mouth was as follows :—

	£	s.	d.
New South Wales .....	0	6	4
Victoria .....	0	11	1
Queensland .....	0	8	6
Tasmania .....	0	8	6
New Zealand .....	0	11	0
Australasia .....	0	7	9

The average price in New South Wales during 1895 fell to 5s. 10d.

*Anthracite* is found on the island of Tasmania. It is a hard and heavy mineral, burning with difficulty, and possesses very little commercial value in countries where ordinary coal abounds.

The following table shows the annual coal production of the principal countries of the world to the latest date obtainable :—

Country.	Tons of 2,240 lb.
Great Britain (1894) .....	188,278,000
United States (1893) .....	162,815,000
Germany (1893) .....	93,893,000
Austria (1893) .....	26,122,000
France (1893) .....	25,239,000
Belgium (1893) .....	19,098,000
Canada (1894) .....	3,444,000
Australasia (1894) .....	4,865,000



*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 it yields a much larger percentage of volatile hydrocarbons than can be obtained from the Scottish mineral. The richest quality of Australian kerosene shale yields upwards of 150 gallons of crude oil per ton, or 18,000 cubic feet of gas, with an illuminating power of 38 to 48 sperm candles. 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 1894, the quantity of kerosene shale raised has amounted to 804,069 tons, worth £1,685,792. The average price realised during that period has been £2 1s. 11d. per ton. The prices ruling in 1894, when 21,171 tons were extracted, averaged £1 10s. per ton, representing a total value of £31,781 for the production of that year. The export of shale from New South Wales during 1892, 1893, and 1894 was as follows:—

Exported to—	1892.		1893.		1894.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£
Victoria .....	3,559	9,940	2,997	8,646	1,328	2,849
United Kingdom .....	7,717	22,879	6,236	18,034	8,019	21,059
Netherlands .....	18,578	54,301	8,064	22,714	5,884	15,727
Italy .....	1,045	3,330	4,064	11,497	1	3
United States .....	1,210	3,354	603	1,752	152	418
Spain .....	3,438	10,528	1,735	5,292	.....	.....
Brazil .....	4,180	12,285	.....	.....	.....	.....
Chili .....	1,950	5,616	2,328	6,888	1,914	4,886
Other countries .....	3,119	9,540	1,718	5,096	1,561	4,245
Total .....	44,796	131,773	27,745	79,919	18,859	49,187

In 1895 the production of shale in New South Wales amounted to 59,426 tons, valued at £75,219.

Extensive formations of oil shale have been found in New Zealand at Otago, and at Orepuki, in Southland. Attempts have been made to develop the oil resources of Waipaoa, but so far unsuccessfully. The oil produced does not possess the properties required in illuminating oils, although it is valuable for lubricating purposes.

The net import of kerosene into Australasia in 1894 is shown below. The figures for Western Australia include a small quantity of turpentine :—

Colony.	Quantity.	Value.
	gallons.	£
New South Wales .....	2,002,347	51,888
Victoria .....	3,488,912	66,000
Queensland .....	1,299,505	39,931
South Australia ..	1,030,526	16,683
Western Australia .....	277,968	9,726
Tasmania .....	205,673	6,174
New Zealand .....	1,435,336	48,595
Australasia.....	9,740,267	238,997

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

*Elaeterite*, mineral caoutchouc, or elastic bitumen, is said to have been discovered in New South Wales and South Australia. In the last-named colony 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 production an exudation from trees, is found only in the Auckland province of New Zealand, where it is included under the head of minerals, although more logically entitled to be considered as a vegetable product. The best sort is 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 1894 was £7,264,753. In the year 1894 the quantity obtained represented a value of £404,567, and it is estimated that about 5,750 white people and 1,250 Maoris were engaged in digging for the gum. Kauri gum is not 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 large deposits so as to be of commercial importance. *Natron* is said to occur in the neighbourhood of the Namoi River, in the same colony. 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 found in various 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 1894, 3,428 tons of alumite had been raised there, most of which had been sent to England for treatment. It is said to yield well, and a quantity of the manufactured alum is sent to Sydney for local consumption. During 1894 the Bulladelah mine yielded 862 tons of stone, valued at £3,448. In the course of the same year 278 cwt. of locally-manufactured alum, valued at £78, was exported to Victoria, Queensland, New Zealand, and New Caledonia.

#### EARTHY MINERALS.

*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.

*Lithographic stone* has been found in New Zealand, where another beautiful species of limestone known as the *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 large quantities of the stone for the embellishment of public edifices.

*Limestone* is being worked on the Myall Lakes, near Bungwall, and small quantities have been forwarded from this district to Sydney.

*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. This mineral is of commercial value for the manufacture of cement and plaster of Paris. It is 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 AND SILICA.

*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.

Common *Opals* are frequently found in the basaltic formations of Australasia. The precious or noble opal, which might be included under

the head of precious stones, has been found 60 miles north-west from Wilcannia, at a few feet from the surface, in layers between hard silicious sandstone. As much as £5 per oz. has been offered for good specimens. During 1894 the quantity of noble opal won from these mines was 198 lb., valued at £5,684. The total production to the end of that year was 884 lb., valued at £35,599. The gem has also been found in basalt, near the Abercrombie River, and in sandstone, near Lismore. In Queensland opals are found in the Thargomindah district, where in 1894 the labour of 50 to 300 men, according to the season, produced opals valued at £12,000. Opal-bearing stone is known to exist in the ranges between Adavale and Cooper's Creek, in the Charleville district, Queensland; and in the northern portions of New South Wales.

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

*Mica* is also found in granitic country, chiefly in the New England and Barrier districts. In Western Australia very good mica has been found at Bindoon, and also on the Blackwood River, near Cape Leeuwin. Some promising discoveries have been made near Herberton, in Northern Queensland; and recently some mica of excellent quality was brought to Adelaide from the Macdonnell Ranges, in Central Australia.

#### CLAYS.

*Kaolin*, *fire-clays*, and *brick-clays* are common to all the colonies. 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.

*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.

#### GEMS AND GEMSTONES.

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

*Diamonds* are found in New South Wales, Victoria, and Queensland, but only in the first-named colony have any attempts been made to work

the diamond drifts. The principal diamond-fields are situated in the Bingara and Inverell districts, on the New England tableland; and at Cudgegong, in the Wellington district. The Government of New South Wales has on various occasions obtained the services of experts to report upon the fields, as well as upon the gems which have been from time to time extracted from them, and these reports have generally been of an encouraging nature.

The number of diamonds found in the Bingara district is estimated to be 102,000, weighing 150,000 carats, the largest being one of  $5\frac{5}{8}$  carats, or 16.2 grains. The diamonds occur in old Tertiary river-drifts, and in the more recent drifts derived from them. The deposits are extensive, and have not yet been thoroughly prospected. The New South Wales diamonds are harder and much whiter than the South African diamonds, and are classified as on a par with the best Brazilian gems. During the year 1887 the diamond companies at Cope's Creek, near Bingara, produced about 23,000 diamonds, weighing 5,151 carats; but in 1888, owing to the severe drought which occurred, the search had to be temporarily abandoned. In 1889 finds were reported to the extent of 2,196 carats, valued at £878. In 1891 and 1892, 12,000 and 2,250 carats of diamonds respectively were won in the Tingha and Inverell districts, but no value is given. The yield for 1893 is stated at 15,000 carats, valued at £15,375. During 1894 prospecting only was carried on. With efficient methods of working, this industry bids fair to become a profitable one.

Under the generic name of *Corundum* are included the most valuable gems known to commerce, next to the diamond. The *sapphire*, which is the most common of these gems, is found in all the colonies, principally in the neighbourhood of Beechworth, Victoria.

Oriental *emeralds* are found in New South Wales, and in Gippsland, in Victoria. An emerald mine, in which the gem occurs in granitic lode, was opened near Emmaville, in the Glen Innes district, during 1890, and to the close of 1893 the Emerald Proprietary Company obtained some 25,000 carats in a rough state, the value of which, when cut and finished, was expected to reach about £2 per carat. No work was done in 1894.

The yellow corundum, or Oriental *topaz*, has been found in New South Wales. Oriental *amethysts* also have been found in that colony, and the red corundum, or *ruby*, the most valuable of all these gems, 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, and mining operations were carried on for some time, but without satisfactory results.

*Chrysoberyls* have been found in New South Wales ; spinel rubies, in New South Wales and Victoria ; white topaz, in all the colonies ; and yellow topaz, in Tasmania. *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 South Australia.

#### 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, have only reached the first period of their exploitation. Vast beds of silver, tin, and copper ore and of coal are known to exist, but their development 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 colonies in 1894 will be found below :—

Colony.	Total Value.	Proportion of each Colony.	Average value per head.
	£	per cent.	£ s. d.
New South Wales .....	4,857,738	36·0	3 18 6
Victoria ..	2,815,290	20·9	2 7 10
Queensland .....	2,650,848	19·7	6 0 10
South Australia .....	358,601	2·7	1 0 5
Western Australia .....	802,373	5·9	10 18 2
Tasmania.....	698,708	5·2	4 9 7
New Zealand .....	1,292,675	9·6	1 18 1
Australasia .....	13,476,233	100·0	3 5 7

The total value of minerals raised in 1894 exceeded by £2,416,194 the average annual amount since 1852. It will, however, be easily understood that the proportion of mineral wealth extracted per head of the population is much less than it was during the prevalence of the gold fever. In comparison with that of the years 1851 to 1871 the production of the precious metals is considerably reduced. The search for gold, however, led to the expansion of the mining industry in other directions, and although seekers of gold have become fewer, the number of miners engaged in the extraction of other minerals has largely

increased, and it is a question whether the total number of persons who gain their livelihood by mining pursuits at the present time is not equal to the number so engaged when gold and coal alone were the elements of the mineral production of the Australasian colonies. The resources known to exist and to be developed in these colonies are likely to maintain for many generations to come a large and prosperous mining population.

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

Colony.	1871.	1881.	1891.
	£	£	£
New South Wales .....	1,650,000	2,121,000	6,395,560
Victoria .....	5,400,000	3,467,000	2,339,510
Queensland .....	806,000	3,165,000	2,299,560
South Australia .....	725,000	421,000	365,950
Western Australia .....	5,000	11,000	130,090
Tasmania .....	25,000	604,000	516,390
New Zealand .....	2,932,000	1,274,000	1,403,630
Australasia {	Total .....	11,543,000	11,063,000
	Per head .....	£ s. d. 5 19 4	£ s. d. 3 19 8
		£ s. d. 3 10 0	

A comparison of the figures for 1891 with those for 1894 shown in the preceding table reveals the fact that the mineral production of 1894 was about £25,000 more than that of 1891. There were increases in Victoria, Queensland, Tasmania, and notably in Western Australia, and slight decreases in South Australia and New Zealand, while in New South Wales the decrease amounted to £1,538,000, chiefly owing to the fall in the value of silver and, to a smaller extent, to the decline in the price of coal.

Comparing the value of mineral production in 1894 with the population, the largest share is taken by Western Australia, with £10 18s. 2d. per inhabitant ; Queensland ranks second with £6 0s. 10d. per inhabitant ; Tasmania third, with £4 9s. 7d., and New South Wales fourth, with £3 18s. 6d. The high averages of Western Australia and Queensland are due to the gold-mines, while in New South Wales nearly half the year's wealth was contributed by the silver-fields. The average per inhabitant for Australasia was £3 5s. 7d.

The following table shows the value of production in each of the colonies during 1894, distinguishing the principal minerals. With regard to some of the colonies the data are defective in respect to "other minerals," but not to such an extent as to seriously affect

# VALUE OF MINERAL PRODUCTION.

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the gross total. The column "other minerals" includes kerosene shale in New South Wales :—

Colony.	Gold.	Silver and Silver-lead.	Copper.	Tin.	Coal.	Other Minerals.	Total.
	£	£	£	£	£	£	£
New South Wales ....	1,156,717	2,289,489	63,617	85,264	1,155,573	107,078	4,857,738
Victoria .....	2,604,722	6,253	14,702	2,286	94,990	2,268	2,815,290
Queensland .....	2,378,289	22,077	9,582	102,277	114,593	24,030	2,650,848
South Australia .....	142,793	.....	210,602	1,251	11	3,944	358,601
Western Australia .....	787,000	.....	.....	15,274	.....	.....	802,373
Tasmania .....	225,485	293,043	5,000	150,865	13,184	5,131	698,708
New Zealand .....	887,839	6,697	.....	.....	395,709	2,430	1,292,675
Australasia .....	8,272,944	2,617,559	303,563	363,217	1,774,069	144,881	13,470,233

Corresponding figures for the year 1895 are appended :—

Colony.	Gold.	Silver and Silver-lead.	Copper.	Tin.	Coal.	Other Minerals.	Total.
	£	£	£	£	£	£	£
New South Wales ....	1,315,029	1,642,671	136,069	87,937	1,095,327	134,747	4,413,580
Victoria .....	2,960,344	7,600	210	3,131	118,400	1,240	3,090,925
Queensland .....	2,210,887	30,042	13,097	68,133	132,530	41,287	2,495,976
South Australia .....	128,842	.....	228,575	815	.....	3,879	362,111
Western Australia .....	879,748	.....	12,052	9,703	.....	3	902,406
Tasmania .....	212,730	227,916	9,677	67,754	14,029	726	532,832
New Zealand .....	1,162,164	10,679	.....	.....	411,477	2,891	1,587,211
Australasia .....	8,870,644	1,918,908	401,480	237,473	1,771,763	184,773	13,385,041

" The total mineral production to the end of 1895 is shown in the following table, in which the column "other minerals" again includes kerosene shale :—

Colony.	Gold.	Silver and Silver-lead.	Copper.	Tin.	Coal.	Other Minerals.	Total.
	£	£	£	£	£	£	£
New South Wales ....	42,326,598	20,624,595	3,870,355	6,127,972	30,694,051	2,373,745	106,017,316
Victoria .....	240,744,434	820,823	206,395	687,737	355,295	210,503	243,025,187
Queensland .....	36,055,118	629,553	1,987,074	4,325,771	1,837,323	170,239	45,905,078
South Australia .....	1,822,923	101,727	20,816,244	24,482	11	418,342	23,183,734
Western Australia .....	3,035,233	250	166,716	65,854	.....	169,153	3,437,206
Tasmania .....	3,146,347	856,724	166,567	6,128,516	314,559	10,653	10,623,366
New Zealand .....	51,351,002	171,263	17,866	.....	5,309,476	205,126	57,054,733
Australasia .....	379,381,660	23,204,935	27,231,217	17,360,332	38,510,715	3,557,761	489,246,620

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 1895, the remainder, £488,966,697, represents the value of mineral production from 1852, equal to an average of £11,112,880 per annum for the forty-four years.