MINERAL RESOURCES.

ALMOST 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, diamonds and other gem stones, has been adopted.

NOBLE METALS.

Gold.

Gold, the most valuable of noble metals, is found throughout Australasia, and the present prosperity of the Colonies is largely due to gold discoveries, the development of other industries being, in a country of varied resources, a natural sequence to the acquisition of mineral treasure.

Discovery of gold.

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 Queensland, took place in 1858; and gold was discovered in New Zealand in that year, but it was not until 1861 that a large population was, by the prospect of rapidly obtained wealth, attracted to the last-mentioned place. It would be strange if Western Australia could not also claim the possession of auriferous deposits, and, although for many years belief in the existence of gold in that Colony was simply speculative, the reports of explorers in the Kimberley District, and subsequent developments, proved that the great territory of the west has a share of the treasure.

Weight and value of gold raised.

The following table gives the weight and value of gold raised from the start of mining in the various Colonies to the end of the year 1888:—

Colony.	Period.	Weight.	Value.
		oz.	£
New South Wales	1851–1888	9,972,598	37,180,817
Victoria	,, ,,	55,635,959	222,543,836
Queensland	1858 ,,	6,088,785	21,310,747
South Australia	1852 ,,	248,213	891,612
Tasmania	,, ,,	532,893	2,031,520
New Zealand	1858 ,,	11,421,817	44,843,642
Western Australia	1886 ,,	54,873	219,492
Australasia	1851–1888	83,955,138	329,021,666

Effect of gold discovery in Victoria.

It will be readily understood from the foregoing figures how Victoria, though comparatively small in area, achieved the foremost position amongst the Colonies, and retained that place so long as the powerful attraction of gold continued; but as the alluring dazzle of the gold-seeker's life was gradually dimmed by privation and frequent disappointment, people turned to safer, if less brilliant, fields of employment, and 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. Notwithstanding this only a small portion of the auriferous area of the continent has been explored, and a still smaller portion fully developed.

Number of gold-miners.

The number of men engaged in the search for gold cannot be ascertained with any degree of accuracy, as returns are not available from some of the Colonies. An approximation, based upon the number of miners and the average production per man at the date of the last census taken in the Colonies, will give a fairly reliable estimate, information to date not being available, and, with the figures obtained from the other Colonies, shows the following as the number of persons engaged in gold-mining in Australasia in the year 1888 :—

New South Wales	8,278
Victoria	25,142
Queensland	9,240
South Australia	440
Western Australia	800
Tasmania	900
New Zealand	9,370
Australasia	54,170

The weight and value of gold obtained was :—

Colony.	Weight.	Value.
	oz.	£
New South Wales	87,503	317,100
Victoria	625,026	2,500,104
Queensland	481,643	1,685,750
South Australia	16,763	66,160
Western Australia	50,000	200,000
Tasmania	39,610	147,154
New Zealand	201,219	801,066
	1,501,764	5,717,334

Average amount of gold obtained.

The average per miner may be calculated from the preceding tables, and, as the conditions under which mining is carried on greatly differ, will be found to vary considerably. In New South Wales, for example, a revival of gold-mining, especially reefing, took place during the year 1888, and there was, consequently, a considerable increase in the number of persons employed, many being engaged in developing mines which had not reached a payable stage. In Queensland and Tasmania, on the other hand, a small number of miners, working exceptionally rich ground, produce a large yield, and thus the average for those Colonies is increased.

The quantity and value of gold per miner for the year 1888 are given below, Western Australia being excluded, as the returns are not reliable :—

	oz.	£	s.	d.
New South Wales	10·57	38	6	1
Victoria	24·86	99	8	9
Queensland	52·09	182	6	9
South Australia	38·27	151	1	0
Tasmania	44·35	164	15	7
New Zealand	21·47	85	10	0

In New South Wales the average was smaller for 1888 than for previous years, owing to causes already explained, that for 1887 being 18·19 oz., valued at £65 2s. 3d. per miner.

Yield of quartz.

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 material from all the principal mining centres. The results obtained in 1887 and 1888 are given below :—

	New South Wales.	Victoria.	Queensland.	Tasmania.
	oz. dwt. grs.	oz. dwt. grs.	oz. dwt. grs.	oz. dwt. grs.
1887	0 9 4·93	0 9 9·95	1 15 10	1 5 21
1888	1 0 18·22	0 9 17·96	1 14 11	1 5 2

The data on which the estimate for Queensland is based are probably below the mark, as the Mount Morgan returns are not included in the calculations. It is not pretended that the above figures have any great statistical value, but they may, nevertheless, 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.

Large nuggets.

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 the weight and value of which were never published, or, being merely ascertained from report, left a wide margin for exaggeration. Victoria's record is the best, and includes the following nuggets :—

Victorian 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	1	17
	93	1	11
	84	3	15
	69	6	0
	52	1	0
	30	11	8
	30	11	2

Nuggets found in New South Wales.

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 to 1,393 oz., and others, of 357, 347 (the "Jubilee"), 200, 47, 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 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 during the year 1873, for this mine, 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 are, however, insignificant when compared with the enormous yield of the Mount Morgan Mine, in Queensland, which has already paid over £1,000,000 in dividends, and may be designated one of the wonders of the world. It 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.

The Mount Morgan mine.

The greatest development of quartz-reefing is found in Victoria, some of the mines being of a great depth. Lansell's, at Sandhurst, is down 2,640 feet, the "Magdala-Moonlight," at Stawell, is worked to a depth of 2,409 feet, whilst the "Victorian Quartz Mine," the "Victory and Pandora," and the "New Chum and Victoria" have, respectively, shafts extending 2,302, 2,300, and 2,228 feet below the surface.

Deep mines in Victoria.

The gold-mining industry is at present in a vigorous state in Queensland and Victoria, but is in a somewhat languishing condition in the other colonies.

Platinum and iridosmine, though not specially sought for by miners, have been found in New South Wales and New Zealand, but no effort has been made to ascertain whether either mineral can be extracted with satisfactory commercial results.

Platinum and Iridosmine.

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).

Tellurium.

Silver.

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, or argentiferous lead ores, the largest deposits of the metal being found in the last-mentioned form.

Barrier Ranges and Broken Hill silver-lead mines.

The argentiferous lead ores of the Barrier Ranges and Broken Hill districts of New South Wales have, more than any other, attracted the attention of capitalists. 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 on the confines of the neighbouring Colony of South Australia. Numerous leases have been taken up, and many ventures floated into public companies, giving rise to a large amount of speculation in shares in the mining exchange of Silverton, and the capital cities of the Australian colonies, recalling the old days of gold discoveries. 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.

Broken Hill Proprietary Company.

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 June, 1889, the company treated 208,657 tons of silver and silver lead ores, producing 9,352,500 oz. of silver and 37,450 tons of lead, valued in the London market at £2,055,000. They

have paid dividends to the amount of £1,144,000, and have assigned to their shareholders properties valued at £1,744,000, so that the total value of payments made has reached £2,888,000.

The ores are generally shipped to Europe for treatment, as it has been found difficult to economically and profitably reduce them in the colonies. The value of metal exported in the years 1885 and 1886 was greatly in excess of that of the ore shipped; but the reverse is now the case—the value of the ore in 1888 being nearly three times that of the silver.

Exports of silver and silver-lead.

The following table gives the quantity and value of silver and silver-lead exported from New South Wales :—

Year.	Silver.		Silver lead Ore.			Total Value.
	Quantity.	Value.	Quantity.		Value.	
			Ore.	Metal.		
Up to	oz.	£	Tons cwt.	Tons cwt.	£	£
1881	726,770	178,405	191 13	.....	5,025	183,430
1882	38,618	9,024	11 19	.....	360	9,384
1883	77,065	16,488	136 4	.....	2,075	18,563
1884	93,660	19,780	9,167 11	.....	241,940	261,720
1885	794,174	159,187	2,095 16	190 8	107,626	266,813
1886	1,015,433	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	29,841 12	.....	1,075,737	1,142,405
Total.....	3,298,101	679,554	58,776 0	190 8	2,269,200	2,948,754

Probable increase of silver mining.

It will be seen that the production of silver has, during the past few years, considerably increased. Since the important discoveries of silver deposits were made sufficient time has hardly elapsed to enable all the principal mines to be properly developed; but it may be confidently expected that, as new deposits are opened, and the mines first discovered are brought into full working order, the exports of this metal will rapidly increase.

Capital value of the New South Wales silver mines.

A recent calculation, based on the price of stock, gives the nominal capital value of the principal New South Wales silver-mines as follows :—

Broken Hill Proprietary	£12,320,000
Central	1,706,000
British	1,320,000
Block 10	1,275,000
South	1,350,000
Block 14	1,012,000
Junction	637,500
North	255,000
Round Hill	184,000
Sunny Corner	200,000
Block 5	162,500
Lewis Ponds	23,500
Toms Lewis Ponds	55,000
Total...	£20,477,000

Total production of silver in Australasia.

This industry is also carried on in Queensland and Western Australia. The total value of metal and ore extracted up to the end of the year 1888 amounted to :—

New South Wales	£2,948,754
Victoria	87,618
Queensland	358,572
Western Australia	320,381
Tasmania	800
South Australia	2,800
New Zealand	124,792
Australasia	£3,843,717

About one-half of the total just given represents the production of the years 1887 and 1888 (£1,861,848) ; and the output of silver is rapidly increasing from year to year, with the development of the numerous and valuable properties in the Barrier and Broken Hill Districts.

Persons employed in silver-mines.

There were 4,215 persons employed in this industry in New South Wales during the year 1888. In Queensland, according to the census of 1886, 178 silver-miners were at work. The foregoing are the only figures obtainable on this point. The average value of mineral ore per miner is about £271 yearly.

METALLIC MINERALS.

Lead is found in all the colonies, but is worked only when found associated with silver. In the colony of Western Australia, however, the quantity of silver mixed with the lead, which occurs in the form of sulphides and carbonates of great richness, is very small. The lodes contain so little gangue that the ore can be very easily dressed to 83 or 84 per cent. The Government offered £10,000 for the first 10,000 tons of lead smelted in the colony. Works were erected, but up to the present with not much success. Western Australia has, since 1845, exported 31,105 tons of lead ore. Lead.

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. Mercury.

Copper is known to exist in all the colonies, but 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 Mines were opened up in the year 1843, and two years afterwards the celebrated Burra Burra, for a long time the richest copper-mine in the world, was discovered. In 1860 the Wallaroo, and in 1862 the Moonta Mines were first worked. Altogether copper has proved one of the richest resources of that colony; the value of the ore raised in the Wallaroo and Moonta Mines alone reached £6,584,520. Copper.

In New South Wales this branch of mining industry, though it attracted considerable capital, never affected the progress or prosperity of the Colony in the same degree as in South Australia. Copper lodes were discovered in 1858 at Cobar, in a district then New South Wales copper.

considered a barren wild. For some years the industry languished, until, in 1876, a smelting plant was erected at the Great Cobar mine with most satisfactory results. Other mines were discovered giving sufficient promise to warrant the expenditure of capital; works were established at Lithgow, Newcastle, and Sydney, at which the ore from the smaller mines was treated or refined; but of late years, owing to the depressed state of the market, cost of carriage, local scarcity of fuel, and other causes, work at the Cobar mine has been stopped. The construction of a railway now under consideration, connecting Sydney with the Broken Hill district *via* Nyngan, Cobar, and Wilcannia would, it is confidently expected, lead to the reopening of the Great Cobar works.

Copper in Queensland.

Cupriferous deposits abound in the Colony of Queensland, and at one time there was considerable speculation in copper-mining stock. 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 near the rivers Palmer and Kennedy. The great distance of the Queensland mines from ports of shipment, and the lack of suitable fuel for smelting purposes, renders the economic treatment of the ore difficult or impossible, and the progress of the industry is consequently retarded.

Victorian copper.

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 metal is sometimes found in the Australasian mines in a virgin state, of which beautiful specimens have been exhibited at different times, but occurs generally in the form of oxidized 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*.

Copper in Western Australia

In Western Australia copper deposits have been worked for some years, and form with lead the principal elements of the mineral production of that Colony. Very rich lodes of both metals have been found in the Victoria district, from Geraldine on the Lower Murchison River almost to Champion Bay. The export of copper since 1845 has been 7,917 tons.

New Zealand copper.

The copper deposits of New Zealand have been worked to a small extent only.

The number of miners employed in this industry is 1,213 in New South Wales, and 1,623 in South Australia. Figures relative to the other colonies are not available.

The total value of copper produced in Australia to the end of the year 1888 is given below :—

	£
New South Wales	5,438,262
Victoria	191,022
Queensland	1,655,804
South Australia	19,186,163
Western Australia	514,605
New Zealand	17,862
Australia	27,003,718

Tin.

Tin was known to exist in Australasia almost from the first years of colonization, 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 Rev. Tenison-Woods, appears to be very great.

The stanniferous deposits of New England.

The stanniferous deposits of the New England district of New South Wales are very rich, and have added greatly to the value of the mineral production of the Colony.

Fluctuations in the price of tin.

The tin-mining industry may be said to have been started in the year 1872, and 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—reached as high as £114 in 1880 and 1882, and fell to £72 in 1884. The highest price—£168 per ton—was attained in the year 1887 owing to the speculations of French syndicates. At present the price is £94 per ton.

The production of tin for the period 1872–1888 was valued as follows :—

	£
New South Wales	8,510,372
Victoria	665,710
Queensland	5,138,919
South Australia	1,057
Tasmania	4,366,483
Australasia	18,682,541

The number of persons engaged in tin-mining in 1888, within the colonies of New South Wales and Tasmania, was 5,411. Figures for the other colonies for that year are not available, but there were in Queensland in 1886 tin-miners to the number of 877.

Titanium.

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

Wolfram (tungstate of iron and manganese) occurs in some colonies, notably New South Wales, Victoria, and New Zealand. 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. The above minerals—titanium, tungsten, and molybdenum—have not been systematically mined for. Wolfram.

Zinc ores, in the several varieties of carbonates, silicates, oxide, sulphide, and sulphate of zinc, have attracted little attention. Zinc.

Iron is distributed throughout Australasia, principally in New South Wales, Victoria, Queensland, and New Zealand. Iron.

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.

Works for the treatment of local titanic 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 Wainamatta shale, near Nattai, and are enhanced in value through being in proximity to coal-beds Near Lithgow extensive deposits of limonite or clay-band ore are interbedded with coal. Some years ago these deposits were treated by a local company, and, as they contain about 50 per cent. of iron, a successful issue was anticipated, but from causes ascribed to a number of local impediments the works at Eskbank have been closed for some time. Extent of Deposits of iron ore.

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.

Pyrites. Sulphuretted iron ores (pyrites) are of little intrinsic value, but are often 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, 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. *Nickel*, so abundant in the island of New Caledonia, has, up to the present, been found in only one of the Australasian Colonies—Queensland; but no attempt has been made to prospect systematically for this valuable mineral.

Cobalt. *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. *Manganese* probably exists in all the Colonies, deposits having been found in New South Wales, Victoria, Queensland, and New Zealand, the richest specimens being 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 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.

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. Chrome.

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 on Louisa Creek, near Mudgee. Sulphur.

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. Arsenic.

Antimony is met with in New South Wales, where it is frequently found in association with gold. It also occurs in Victoria, Queensland, and South Australia. In New Zealand it is mined for on a fairly extensive scale. The value of the antimony, produced in the several colonies during the year 1888, was :— Antimony.

	£
New South Wales	2,918
Victoria	19
Queensland	229
South Australia	1,973
New Zealand	6,246
Australasia	11,385

The antimony produced in New South Wales alone, up to the end of 1888, was valued at £70,157. In Victoria, from 1851 to the end of 1857, antimony was raised to the value of £191,021, but during the last few years the production has fallen off very greatly; indeed in that Colony this industry may almost be looked upon as a thing of the past.

Bismuth is known to exist in all the Australian Colonies, but up to the present time has been mined for in New South Wales alone. Bismuth.

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 the Colony mentioned. The principal mine is situated at Kingsgate, in the New England District, where it is generally associated with molybdenum and gold. Bismuth to the value of £3,911 was produced in New South Wales during the year 1888, and up to the end of that year the total production of bismuth in that Colony, since the industry was started, amounted to £24,487.

CARBON MINERALS.

The Australian Colonies have been bountifully supplied by nature with mineral fuel. The eastern portion of the continent possesses a coal formation, extending in a broken line almost along its whole extent from north to south. It occurs in the form of brown coal or lignite in Gippsland (Victoria). In New South Wales it appears as ordinary coal, from Jervis Bay to the basin of the Hunter River, and extends inland beyond the Blue Mountains as far as Dubbo. It reappears in the north-eastern part of the Colony, where the Clarence River series occupies a large area, extending into Queensland, where deposits of this mineral are known to exist, cropping out from place to place along almost the whole of the eastern coast. A systematic description of the occurrence of carbon minerals in these Colonies will be given in the following paper, in which they will be dealt with in their natural order.

The Diamond.

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.

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 the coal measures come into contact with the graphite. This mineral, up to the present time, has not been

discovered in any of these colonies except New Zealand, but a kind of carbonaceous clay has been found in New South Wales, which has sometimes been mistaken for plumbago by unscientific persons.

In the excellent work of Messrs. Cox and Ratte, upon Mines and Minerals, published for the Technical Education series in New South Wales, to which we have been much indebted in this compilation, a classification is given with regard to the occurrence of the principal minerals in the Australasian Colonies. It is stated that five distinct varieties of black coal, forming well characterised types, may be distinguished, which form, with the two extremes of brown coal, or lignite, and anthracite, 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 under the three main heads—lignite, coal, and anthracite only. Coal.

Brown coal or *lignite* occurs principally in the Colonies of New Zealand and Victoria. Attempts have frequently been made to use this mineral for ordinary fuel purposes, but the inferior quality of this class of coal has prevented its use extending beyond the mere locality where it is produced. The fields of lignite in New Zealand are roughly estimated to contain about 500,000,000 tons. Lignite.

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 500,000,000 tons of coal. 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 200,000,000 tons. Coal has been discovered in Victoria, and raised in small quantities for some years past, principally from Ordinary coal.

Tasmanian coal.

Crown lands; but the industry is still, in that Colony, in its experimental stage. 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. 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, but it does not appear that much attention was paid to the fact. 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. It is also reported that coal has been discovered on the Fitzgerald or Phillips River, about 100 to 150 miles east of Albany, in the south-western part of the Colony. According to the Rev. Tenison-Woods the extent of the coal-beds in Queensland is unknown. Mr. Jack, the Government Geologist of that Colony, considers them 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 that Colony for some years, and is progressing satisfactorily.

Discovery of coal.

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 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 the company's monopoly ceased, and public competition stepped in, that the coal-mining industry began to show signs of progress and prosperity. The total amount raised by the company in 1847 was 40,732 tons of coal, from which the quantity has increased to 3,203,444 tons raised in 1888, valued at £1,455,198.

The coal-field of New South Wales.

The coal-fields of New South Wales are situated in three distinct regions—the Northern, Southern, and Western coal districts. The first of these comprises the mines situated in the Hunter River and the Clarence River districts; the second includes the Illawarra district and, generally, the coastal regions to the south of the Metropolis; the third consists of the mountain district on the Great Western Railway line, extending as far as Dubbo. The number of coal-mines registered in New South Wales in 1888 was 71, giving employment to 9,301 persons, of whom 7,622 were employed under ground, and 1,679 above ground. The average quantity of coal extracted per miner, calculated upon the basis of the output for the last ten years, is 474 tons, which at the mean price of coal at the pit's mouth, is equivalent to £217 5s. This amount of production compares favourably with the results attained by miners in the principal coal-raising countries of the world, as the following table, extracted from Mulhall's works, will show :—

Production to each miner.

Country.	Tons of coal raised per miner.	Value at the pit's mouth per ton.	Total value of coal raised per miner.
		£ s. d.	£ s. d.
New South Wales	474	0 9 2	217 5 0
Great Britain	303	0 7 0	106 1 0
United States	295	0 9 0	132 15 0
Germany	270	0 5 0	67 10 0
France	190	0 11 0	104 10 0
Belgium	168	0 7 8	64 8 0
Austria	192	0 6 0	57 12 0

Wages of coal-miners.

In the absence of information as to the average amount of wages paid to coal-miners in other countries an exact comparison is not possible, but it is abundantly clear, that whatever may be the drawbacks to a miner's lot in the Australian Colonies in no other country is it so satisfactory. The foregoing table proves this, for on the improbable supposition that the miner everywhere receives in wages the same proportion of the value of the coal as in New South Wales, that is, about 40 per cent. of the selling price at the pit's mouth, the average earnings in each country would be :—

Country.	Coal per miner.	Wages per ton of coal.	Earnings of miner per annum.
	tons.	£ s. d.	£ s. d.
New South Wales	474	0 3 7	84 18 0
Great Britain	303	0 2 10	42 18 0
United States	295	0 3 7	52 17 0
Germany	270	0 2 0	27 0 0
France	190	0 4 5	42 0 0
Belgium	168	0 3 1	25 18 0
Austria	192	0 2 5	23 4 0

Export of coal from New South Wales.

The Colony of New South Wales requires annually about 1,280,000 tons, or 40 per cent. of the coal it produces; in this quantity are included 200,000 tons of bunker coal supplied to ocean-going steamers; the remaining 60 per cent. is exported to various parts of the world, the other Australasian colonies taking the largest share. Notwithstanding their own local production, the colonies of New Zealand, Tasmania, and Queensland require in addition a considerable quantity of coal to supply their necessities, which they obtain from New South Wales.

The chief customers of New South Wales for coal in the years 1887 and 1888 will be found in the following table, from which an idea may be derived of the extent to which the Colony has developed this branch of its resources.

Countries to which Coal was exported during the years 1887 and 1888.

Country or Port.	1887.		1888.	
	Quantity.	Value.	Quantity.	Value.
	Tons.	£	Tons.	£
Victoria	723,676	379,206	744,425	406,744
United States	299,802	164,983	495,300	282,059
New Zealand	150,399	81,478	140,882	74,841
Chili	53,133	28,750	119,505	67,073
South Australia	127,370	62,715	94,886	51,370
Hongkong	86,092	47,448	48,061	26,868
Tasmania	43,375	23,631	39,999	20,755
India	54,214	30,248	36,143	20,593
Java	51,974	28,739	35,653	19,766
Phillipine Islands	38,821	21,355	34,000	18,908
Celebes	.....	.....	1,367	752
Sandwich Islands	10,720	5,897	23,124	12,749
Singapore	32,040	17,807	21,568	12,194
Western Australia	13,837	7,429	12,296	6,485
New Caledonia	15,153	7,928	11,816	6,303
China	23,187	14,301	10,656	6,439
Peru	9,368	5,578	9,921	5,455
Fiji	21,081	12,067	8,941	4,857
Mauritius	9,916	5,627	7,323	4,076
Queensland	18,613	10,625	7,276	4,098
South Sea Islands	1,701	1,053	5,786	3,343
Canada	.....	.....	4,413	2,437
Mexico	2,310	1,169	2,193	1,206
Ceylon	1,741	1,300	1,685	927
Penang	.....	.....	1,535	1,151
Bolivia	.....	.....	1,351	743
Sumatra	.....	.....	1,130	621
Equador	.....	.....	1,039	585
Kaiser Wilhelm's Land	909	650	603	444
Panama	577	317	.....	.....
British New Guinea	.....	.....	485	340
Cape of Good Hope	433	238	.....	.....
Durban	.....	.....	400	220
Borneo	.....	.....	110	70
Total	1,790,442	960,539	1,923,872	1,064,472

Very little coal is exported from New Zealand and Tasmania, the greater part of that entered as an export being consumed on the steamers trading between those islands and the colonies of continental Australia, or the United Kingdom. New Zealand,

Coal exported from New Zealand and Tasmania.

however, exports some of her bituminous coal, which is of superior quality for gas-works and foundries, to the Australian markets, but this trade is as yet of very limited proportions.

Total production of coal in Australasia.

The total quantity of coal produced in the Australasian Colonies up to the end of 1888 is shown by the following table, which represents the value of the production of each Colony :—

	£
New South Wales	21,154,307
Victoria	25,278
Queensland	903,041
Tasmania	179,650
New Zealand	2,668,480
Australasia	£24,930,756

The quantity of coal extracted annually in these Colonies has now reached over 4,000,000 tons, approaching in value £2,000,000 sterling. In 1888 the quantity raised amounted to 4,170,328 tons, valued at £1,935,776, to which aggregate each Colony contributed in the amounts given in the following table :—

	Tons.	£
New South Wales	3,203,444	1,455,198
Queensland	311,412	127,947
Tasmania	41,577	16,413
New Zealand	613,895	336,218
Australasia	4,170,328	£1,935,776

Victorian coal.

No return was furnished from Victoria for 1888, though no doubt some small quantity of coal was procured during that year. In the year 1887 about 16,510 tons of this mineral were raised in that Colony, at an estimated value of £4,230.

During the year 1888 this industry gave direct employment, in and about the mines, to the following number of persons in the several Colonies :— Number of miners employed.

	Persons.
New South Wales	9,301
Queensland	651
Tasmania	104
New Zealand	1,752
Australasia	11,808

The average price of coal per ton varies in the Colonies in proportion to the quality of the mineral, and the facilities of access. In New South Wales, from 1829 to 1888, the average price obtained was 9s. 9·38d., but the mean of the last ten years is a little below these figures. In 1888 the average price per ton of coal delivered at the mines in the Australasian Colonies was as follows :— Average prices.

	£	s.	d.
New South Wales	0	9	1
Queensland	0	8	2½
Tasmania	0	7	10½
New Zealand	0	10	0

Anthracite is found on the island of Tasmania. It is a hard and heavy mineral, burning with difficulty, and it possesses very little economical value in countries where a superior description of fuel abounds. Anthracite.

Kerosene Shale (torbanite) is found in several parts of the Colony 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 per centage 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 or 40 sperm candles. The New South Wales Oil and Mineral Company, at Joadja Creek, not only raise kerosene shale for export, but also manufacture from it petroleum oil and other products. Since the year 1865, when the mines were first opened, the quantity and value Kerosene shale.

of the kerosene shale raised amounts to 516,121 tons, worth £1,156,782. The average price realised during that interval was £2 4s. 10d. per ton. The prices ruling in 1888, when 34,869 tons were extracted, averaged £2 2s. 3d. per ton, representing a total value of £73,612, for the production of that year.

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

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

Kauri Gum. *Kauri Gum*, a resinous substance somewhat resembling amber in appearance, and like that production an exudation from trees, is found only in New Zealand, where it is included under the head of minerals, although more logically entitled to be considered as a vegetable product. In that Colony kauri gum forms the object of an extensive and lucrative commerce. It is computed that the total value of this product obtained from 1853 to the end of 1888, was £4,686,534. In the year 1888 the quantity obtained represented a value of £380,933.

SALTS.

Rock Salt. Common *Rock Salt* has been found in New South Wales in rock crevices in several parts of the Colony, but it is not known to exist in large deposits so as to be of commercial importance.

Natron. *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 found in various parts of New South Wales. Epsom Salt.

Alunite, or alum stone, is also found in New South Wales. Large deposits are said to occur near Bullah Delah, in the neighbourhood of Gloucester. Fluor spar has been found in New South Wales. Alum Stone.

EARTHY MINERALS.

Marble is found in many parts of New South Wales, 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. Marble.

Lithographic stone has been found in New Zealand, where another beautiful species of limestone known as the *Omaru 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 this stone for the embellishment of their public edifices. Lithographic Stone and Omaru Stone.

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. Gypsum.

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. Apatite.

QUARTZ AND SILICA.

Quartz. *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.

Opals. 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, comes chiefly from Queensland and the northern portions of New South Wales.

Chalcedony, carnelian, &c. *Chalcedony, carnelian, onyx,* and *cat's eye,* are found in New South Wales; probably also in the other colonies, particularly Queensland.

Tripoli. *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. *Meerschaum* is reported to have been discovered near Tamworth, in New South Wales.

Mica. *Mica* is also found in granitic country, chiefly in the New England and Barrier districts.

CLAYS.

Kaolin and other 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 being used for commercial purposes, has not as yet been utilised to any extent.

GEMS AND GEMSTONES.

Many descriptions of gems and gemstones have been discovered in various parts of the Australasian Colonies, but no systematic search has been made for any but 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 at Bingera, near Inverell, in the New England district. The Government of New South Wales has, on various occasions, obtained the services of experts to report upon the fields, as well as the gems which have been from time to time extracted from them, and these reports have generally been of an encouraging nature. Diamonds.

The number of diamonds found in the Colony to the end of 1887 is estimated at 75,000, the largest one being 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 on a par with the best Brazilian gems. During the year 1887 the diamond companies at Cope's Creek, near Bingera, produced about 23,000 diamonds, weighing 5,151 carats; but in 1888, owing to the severe drought which occurred, the search for diamonds had to be temporarily abandoned. 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. Corundum.

Oriental emeralds are found in New South Wales, and in Gippsland in Victoria.

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.

Miscellaneous gems.

According to an authority on the subject of gem-stones, 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.

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 gem-stones of little commercial value, are found in all the Colonies.

In South Australia some very fine specimens of garnet were found, which caused 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.

MINERAL WEALTH OF AUSTRALASIA.

Summary of the mineral resources of Australasia.

The Australasian Colonies may be said to possess invaluable mineral resources, because, although enormous quantities of minerals of all kinds have been won since their first discovery, the deposits, with the exception, perhaps, of gold, have only reached the first period of their exploitation. Vast beds of silver, tin, copper, and coal are known to exist, the development of which must be left to future generations, and the value of which is absolutely beyond computation. The following table gives, in a succinct form, the total value of the principal minerals raised in Australasia from their first discovery to the end of 1888, and it will present to the reader a fair idea of the mineral wealth of these Colonies. With the exception of coal the development of other minerals in Australia was the outcome of the discovery of gold. The figures given below would, therefore, practically represent the mineral production of Australasia from 1852 to 1888 inclusive, if the value of the coal extracted up to the end of the year 1851 is deducted.

Colony.	Gold.	Silver and Silver Ore.	Copper.	Tin.	Coal.	Shale.	Total.
	£	£	£	£	£	£	£
New South Wales	37,180,817	2,948,754	5,438,262	8,510,372	21,154,307	1,156,782	76,389,294
Victoria	222,543,836	87,618	191,022	665,710	25,278	.....	223,513,464
Queensland	21,310,747	358,572	1,655,804	5,138,919	903,041	.....	29,367,083
South Australia	891,612	2,800	19,186,163	1,057	.....	.....	20,081,632
Western Australia	219,492	320,381	514,605	.....	.....	.....	1,054,478
Tasmania	2,031,520	800	.....	4,366,483	179,650	.....	6,578,453
New Zealand..... ...	44,843,642	124,792	17,862	.....	2,668,480	.....	47,654,776
Australasia.....	329,021,666	3,843,717	27,003,718	18,682,541	24,930,756	1,156,782	404,639,180

Total value of minerals.

It is difficult to obtain much information with regard to other minerals raised in most of the colonies, but if to the total just given be added some £405,167 worth of sundry minerals produced in New South Wales, and £4,857,866, nearly the whole of which represents the total value of kauri gum extracted in New Zealand up to the end of 1888, the grand total will be raised to £409,902,213. Deducting therefrom the sum of £279,923, which represents the value of coal raised in New South Wales prior to the year 1852, the difference, £409,622,290, practically shows the total value of the mineral wealth produced by the Australasian colonies from 1852 to 1888 inclusive, and during a period of 37 years, the average yearly production amounted to £11,070,873.

In the year 1888 the total value of minerals raised in each colony and in Australasia was as follows :—

	£
New South Wales	3,856,187
Victoria	2,503,925
Queensland	2,066,979
South Australia	369,014
Western Australia	206,847
Tasmania	520,878
New Zealand	1,531,614
Australasia	11,055,444

The mineral production of Australasia for the year 1888 thus very closely approximates to the average above calculated. 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. Nevertheless the search for gold led to the expansion of the mining industry into other channels, and although the gold-mining population has decreased, 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 who were so engaged at the time when gold and coal alone were the great elements of the mineral wealth of the Australasian colonies. The resources known to exist, and yet to be developed in these colonies, are likely to maintain, for many generations to come, a large and prosperous mining population.