

SECTION XII.

MINES AND MINING.

§ 1. Introduction.

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

That Australia was a gold-producing country was known probably 400 years ago. From the Dauphin chart (1530-1536) preserved in the British Museum, it appears that the north-west coast was called by the Portuguese and Spaniards *Costa d'Ouro*, gold-coast. But the knowledge of Australia as a gold-producing territory was not revived until as late as 1823, when James McBrien, making a survey of the Fish River, between Rydal and Bathurst, in New South Wales, wrote in his field notes—"At this place I found numerous particles of gold in the sand."

Reference to subsequent discoveries will be reserved till later.

2. **Extent of Mineral Wealth.**—The large production of gold, silver, copper, and tin, the extent of the coal deposits, the presence of large quantities of iron ore, and the great variety of minerals found in appreciable quantities, suggest that the future history of mining will, in all probability, be more remarkable even than that of the past. For the extent of the total mineral wealth of Australia cannot yet be regarded as well-ascertained, since the mineral exploration of the country is, after all, still in its infancy. The presence of considerable deposits of valuable metals has long been known. Thus, silver was discovered by Count Strzelecki as early as 1839, and was worked as early as 1864; copper mining dates back to 1844; lead to about 1848, and iron to about 1850. Cobalt, nickel, manganese, chromium, tungsten, molybdenum, mercury, antimony, bismuth, zinc, etc., have all been found, some in fairly large quantities.

Among the more valuable non-metalliferous substances may be mentioned coke, kerosene shale, graphite, alunite, asbestos, diatomaceous earth, clays, ochres, etc.; in building stones, sandstones, syenites, granites, basalts, augite-andesite, porphyries, serpentines, slates, limestones, and marbles; in precious stones, diamonds, emeralds, rubies, sapphires, amethysts, precious opal, turquoise, topazes, garnets, chrysolites, cairngorm, agates, etc. In general it may be said that the variety of Australian mineral wealth is very great.

It will be convenient in the succeeding pages to treat first of all gold and the various metals, then to deal with non-metallic minerals and precious stones, and finally to furnish some account of the total mineral wealth of Australia, and of the extent of employment in mining generally.

METALS (A).

§ 2. Gold.

1. **Discovery of Gold in Various States.**—The discovery of gold in payable quantities was an epoch-making event in Australian history, for as one writer aptly phrases it, this event “precipitated Australia into nationhood.” A reference to the population figures prior and subsequent to the year 1851 amply demonstrates this fact. Thus on 31st December, 1841, the population of the Commonwealth was only 220,968¹; at the end of 1851 it was still under half a million, viz., 437,665¹, while by the end of 1861 the total had reached 1,168,149¹ persons, that is, the population had quintupled itself in twenty years. A short account of the chief discoveries in each State and in New Zealand is appended:—

(i.) *New South Wales.* The first authentic discovery of the precious metal in this State was made by “Assistant-Surveyor” James McBrien, on the 16th February, 1823. Mr. McBrien reported that he had “found numerous particles of gold amongst the sand in the hills convenient to the Fish River,” the locality to which he alludes in his field-book being not far from the scene of Hargraves’ memorable discovery twenty-eight years later. The famous Polish explorer, Count Strzelecki, reported the existence of gold, in the form of auriferous pyrites, in the Vale of Clwydd, near Lithgow, in 1839, but Governor Gipps, to whom he had imparted his discovery, requested him to keep the matter secret, being fearful of the effect that such news might have on the discipline of the infant settlement. The Rev. W. B. Clarke, who, in 1841, discovered gold on the Cox River, and on the Wollondilly in 1842, expressed the belief that a large portion of the newly occupied country would prove auriferous. This opinion was shared by several eminent authorities in England, including Sir Roderick Murchison, and the validity of it was in the first instance amply demonstrated by Hargraves’ world-renowned discovery in 1851. Hargraves, who had gained his experience on the goldfields of California, found payable deposits of alluvial gold at Lewis Ponds and Summer Hill Creek, and on the Macquarie River. The news of these discoveries, amplified and distorted by all sorts of rumours, soon caused an enormous influx of people into Australia. The dates of other important finds were as follows:—Rich alluvial leads at Forbes in 1862, Rocky River, near Uralla, 1856, in beach sands at northern rivers, 1870, Gulgong 1871, Mount Drysdale 1892, Wyalong 1893.

(ii.) *Victoria.* The discovery of gold in the mother colony was quickly followed by discoveries on a larger and more important scale in the neighbouring colony of Victoria. According to the report of the Select Committee of the Legislative Council appointed to inquire into the claims of candidates for the rewards offered, the discoveries took place in the following sequence. The Hon. W. Campbell discovered the precious metal in March, 1850, at Clunes, but concealed the fact temporarily through fear lest the announcement should prove injurious to the squatter on whose run the discovery was made, and the gold-discovery committee was not notified until the 8th July, 1851. On the 5th July, 1851, notification was made of the discovery of gold in the Yarra Ranges by Mr. L. J. Nichel. Mr. James Esmond discovered gold in quartz at the Pyrenees Mountains, the notification being made on the 5th July, and soon after the numerous fields near Mount Alexander were opened up. The chief centres of the gold-mining industry at the present time are in the Bendigo, Ballarat, Beechworth, Castlemaine, Maryborough, Gippsland, Ararat, and Stawell districts. In November, 1906, a remarkable discovery of gold was made near Tarnagulla, where a miner who had prospected the district for years obtained seven ounces of gold from a shaft nineteen feet deep, and some fairly large nuggets being found soon after, the so-called Poseidon rush set in. Several of the nuggets were unearthed within a few inches of the surface. The largest weighed 953 ounces and two

1. Figures for these years were given in “A Statistical Account of Australia and New Zealand for 1903-4” as 206,095; 403,889; 1,153,973 respectively, but those refer presumably to the enumerations in the earlier part of the years mentioned.

others weighed 703 and 675 ounces respectively. The shallow ground was soon worked out, but operations have given satisfactory results in the deeper alluvial.

(iii.) *Queensland.* The news of the discoveries in the southern divisions of the continent fired the minds of the few remaining settlers in Queensland, which at this time was still a portion of New South Wales, with the hope that an El Dorado would be discovered in the north. It was not, however, until the year 1858 that payable gold was struck at Canoona by a party under the leadership of Mr. W. C. Capel. Almost immediately a rush set in from all parts of Australia and also from New Zealand—a rush that was attended with disastrous consequences to many that participated in it, for the alluvial deposits were soon worked out, and many of those who reached the diggings suffered great privations through lack of the ordinary necessities of life. In 1863 gold was found at Canal Creek and Gladstone; Crocodile Creek field was discovered in 1865, Ridglands in 1867, followed shortly afterwards by Rosewood and Gympie; Townsville was opened up in the following year, and the Gilbert River fields in 1869. Charters Towers dates from 1872, the Palmer goldfield from 1873, the Hodgkinson from 1875, while the celebrated Mount Morgan was first worked in 1882. Croydon in 1886, Coen in 1900, and Alice River in 1904.

(iv.) *South Australia.* In South Australia, what is believed to have been the first authentic discovery of gold in the Commonwealth from which actual mining operations resulted was made in January, 1846, at a spot about 10 miles east from the City of Adelaide. Although finds were subsequently made at various places, over large areas, the gold-mining industry has never made very great progress in the State, and South Australia contributes the smallest share of the total gold production of the Commonwealth. Included amongst districts where gold has been found are the southern portion of the main range through Echunga, Talunga, Barossa, and Uooloo to Wonna, about 140 miles north from the city; thence north-east, Mount Grainger, Waukarina, Manna-hill, Wadnaminga, and Olary districts. A good find of alluvial gold was made in 1886 at Teetulpa, about 200 miles north-east by north from Adelaide, and £300,000 worth of the precious metal was obtained from an area of about a square mile. The ground was, however, soon worked out, but there is an immense area of similar country in the surrounding district which has not been systematically prospected. A fair amount of gold has been won from reefs at Tarcoola, 300 miles north-west from Port Augusta, while discoveries have been reported from the Peake and Denison Ranges and Yudnamuntuna, in the northern portion of the Main Range. Arltunga, in the MacDonnell Range, within the boundaries of the Northern Territory, was the scene of a reported rich find in 1902, but the yield has since been small. Up to the 31st December, 1907, the ore treated at the Government battery yielded £42,000 worth of gold. There are numerous deposits of the precious metal at various other localities in the Northern Territory, the chief yield in 1907 being 1045 oz. obtained at the Driffield. A large number of Chinese are engaged in mining in the Territory. In 1907, out of a total of 1166 miners employed, the Chinese numbered 958.

(v.) *Western Australia.* The discovery of gold in Western Australia took place at a much later date than in the eastern States; nevertheless the present production far exceeds in value that of any other portion of the continent. It appears that the precious metal was first detected in 1848, in specimens sent for assay to Adelaide from the Murchison copper and lead deposits. In 1852-53 rich specimens of gold-bearing stone were found by shepherds and others in the eastern districts, but they were unable afterwards to locate the places where the stone was discovered. The late Hon. A. C. Gregory found traces of gold in quartz at the Bowes River in 1854. In 1861 Mr. Panton found gold near Northam, while shortly afterwards a shepherd brought in rich specimens of auriferous quartz which he had found to the eastward of Northam, but he failed to locate the spot again. Various small finds were made up to 1882, when Mr. A. McRae, riding from Cossack to Roeburne, picked up a nugget weighing fourteen ounces. In 1885 Messrs. Hall, Slattery, and others found gold on the Elvire, Margaret, and Ord Rivers. The Kimberley goldfield was opened in May, 1886. Next year the precious metal was

discovered at Yilgarn, and the field was proclaimed in 1888, in which year rich finds were also made at Mallina and Pilbara Creek, the Pilbara field being proclaimed in October. The Ashburton field was proclaimed in 1890, and the Murchison in 1891. From the cap of a reef on the Yalgoo field, proclaimed in 1890, gold to the value of £15,000 was obtained in a very short time by the simple process known as "dollying." In 1892 Bayley and Ford discovered the Coolgardie field, obtaining over 500 ozs. of gold in one afternoon by the aid of a tomahawk. Alluvial was discovered by Frost and party at Goongarrie (the Ninety-mile) in May, 1893. Kalgoorlie (Hannan's) was discovered in June of the same year by Messrs. Flannigan and Hannan, Bardoc in August by Messrs. Cashman and Lee, Siberia by Frost and Bonner in October. There were numerous rich discoveries in 1894, such as at "Mount Jackson," "the Pinnacles," "Billy Billy," and at the celebrated Kanowna diggings. Rich finds were also made at Bulong, Londonderry, and the Wealth of Nations, Mr. J. G. Dunn, the discoverer of the latter, obtaining £20,000 of gold in a few days. The "Norseman" was discovered in July by Mr. L. Sinclair, as also the "Lady Shenton" at Menzies. The "Niagara" was discovered in January, 1895, also the rich field known as the "Hands Across the Sea," at Kunanalling. "Blackboy Hill" field was proclaimed in 1897, "Donnybrook" in 1898, while there were further rich finds in 1899.

(vi.) *Tasmania*. The first discovery of the precious metal in the island State is reported to have been made by a Mr. Riva, of Launceston, who is stated to have traced gold in slate rocks in the vicinity of Nine Mile Springs in 1849. A valuable discovery was made in 1852 at the Nook, near Fingal, and further small finds were reported during the same year from Tower Hill Creek and the vicinity of Nine Mile Springs (Lefroy). During 1859 the first quartz mine started operations at Fingal. In the same year James Smith found gold at the River Forth, and Mr. Peter Leete at the Calder, a tributary of the Inglis. Reef gold was discovered in 1869 at Nine Mile Springs (Lefroy) by Mr. S. Richards. The first recorded returns from the Mangana goldfields date from 1870; Waterhouse, 1871; Hellyer, Denison, and Brandy Creek, 1872; Lisle, 1878; Gladstone and Cam, 1881; Minnow and River Forth, 1882; Branxholme and Mount Victoria, 1883; and Mount Lyell, 1886.

(vii.) *New Zealand*. Gold was discovered in New Zealand by Mr. C. Ring, of Coromandel, who obtained a small quantity in the creek which now bears his name. Further discoveries were, however, prevented by the hostility of the natives, and it was not until 1862 that the district was proclaimed a goldfield. A small find was made in the Middle Island during 1853 at a place called "The Fortifications," now known as the West Taieri goldfield. The first payable field was at Collingwood, in the Nelson district, opened in 1857, in which year the production was about 10,500 ozs. A find of the precious metal was reported from the Lindis River in 1861, but the yield from the locality was small. In June of the same year a rich discovery was made by a former Victorian digger named Gabriel, at the place named Gabriel's Gully, although in 1858 Mr. Edward Peters had found payable quantities on the Tokamarior River, at the locality afterwards known as the Woolshed diggings. Early in 1862 further auriferous deposits were found at Waipori and the Woolshed, while in August of that year Messrs. Hartley and Reilly arrived at Dunedin with over 1000 ozs. of gold obtained from beach sands on the Clutha River, and this discovery was succeeded by other alluvial finds on the tributaries of that stream. The Teviot, Benger, and Upper Manuherikia fields were opened up in March, 1863. In May a rich find was made at Hogburn, leading to further discoveries at Hill's Creek, Dunstan's Creek, Kyeburn, Hyde, Hamilton's, Macrae's, and Mount Buister. At the last-mentioned place, which is 4000 feet above the level of the sea, the deposits can be worked during only about half the year. The next discoveries were made at Cambrian's, Tinker's, Matakanaui, Round Hill, Orepuki, and in recent times at Mount Criffel. Rich finds were made at the end of 1863 at Wakamarina, in the Marlborough district. In 1864 deposits were found in the bed of the Greenstone River by Maoris, and at the present time the mining population in the locality is over 80,000. The rush to the West Coast was soon followed by discoveries of auriferous deposits at Waimeri, Kanieri, Blue Spur, and Ross, and these in turn were

followed by finds at Grey Valley, No Town, Red Jack's, Nobles, Orwell Creek, Antonio's, Maori Gully, Lyell, Charleston, Brighton, and Kumara. In the North Island, the out-crop at the Waihi in the Hauraki district was first noted in 1878.

2. **Production of Gold at Various Periods.**—In the table hereunder will be found the value of the gold raised each year in the several States and New Zealand from the dates when payable discoveries were first reported. Owing to defective information in the earlier years the figures fall considerably short of the actual totals, for during the first stages of mining development large quantities of gold were taken out of Australia by successful diggers, who preferred to keep the amount of their wealth secret. For South Australia the records in the earlier years are somewhat irregular, and the remark applies to some extent also to the returns for Western Australia and Tasmania.

VALUE OF GOLD RAISED IN AUSTRALIA AND NEW ZEALAND, 1851 to 1907.

Year.	N.S.W.	Victoria.	Q'sland.	S.A.	W.A.	Tas.	C'wealth.	N.Z.	Aust'l'sia.
	£	£	£	£	£	£	£	£	£
1851	468,336	851,596	...	...	...	...	1,319,932	...	1,319,932
1852	2,660,946	9,146,140	...	...	...	...	11,807,086	...	11,807,086
1853	1,781,172	10,976,392	...	...	...	...	12,757,564	...	12,757,564
1854	773,209	8,873,932	...	...	...	...	9,647,141	...	9,647,141
1855	654,594	11,277,152	...	...	...	...	11,931,746	...	11,931,746
1856	689,174	12,214,976	...	8,800	...	...	12,912,950	...	12,912,950
1857	674,477	11,320,852	...	876	...	...	11,996,205	40,422	12,036,627
1858	1,104,175	10,384,924	...	2,348	...	...	11,491,447	52,464	11,543,911
1859	1,259,127	9,394,812	...	730	...	...	10,654,669	28,427	10,683,096
1860	1,465,373	8,896,276	11,631	...	...	...	10,373,280	17,585	10,390,865
1861	1,806,171	8,140,692	3,137	...	...	...	9,950,000	751,873	10,701,873
1862	2,467,780	6,920,804	499	12,442	...	...	9,401,525	1,591,389	10,992,914
1863	1,796,170	6,779,276	11,820	...	...	...	8,587,266	2,431,723	11,018,989
1864	1,304,926	6,489,788	66,513	...	...	...	7,861,227	1,856,837	9,718,064
1865	1,231,243	6,446,216	74,216	...	...	...	7,751,675	2,226,474	9,978,149
1866	1,116,404	6,187,792	68,325	...	...	...	7,372,521	2,844,517	10,217,038
1867	1,053,578	6,005,784	151,125	...	...	4,382	7,214,869	2,698,862	9,913,731
1868	994,665	6,739,672	473,956	2,936	...	2,536	8,213,765	2,504,326	10,718,091
1869	974,149	6,179,024	417,681	15,593	...	514	7,586,961	2,362,995	9,949,956
1870	931,016	5,217,216	390,925	24,217	...	7,475	6,570,849	2,157,585	8,728,434
1871	1,250,485	5,475,768	492,635	6,000	...	14,218	7,239,106	2,787,520	10,026,626
1872	1,644,177	5,325,508	527,365	6,363	...	16,055	7,519,468	1,731,261	9,250,729
1873	1,396,375	4,681,588	572,996	293	...	18,390	6,669,642	1,987,425	8,657,067
1874	1,041,614	4,390,572	1,082,899	4,175	...	18,491	6,537,751	1,505,331	8,043,082
1875	877,694	4,273,668	1,196,583	7,034	...	11,982	6,366,961	1,407,770	7,774,731
1876	613,190	3,855,040	1,140,282	9,888	...	44,923	5,663,323	1,284,328	6,947,651
1877	471,448	3,238,612	1,043,780	...	...	23,289	4,777,129	1,496,080	6,273,209
1878	430,200	3,032,160	1,149,240	1,225	...	100,000	4,712,825	1,240,079	5,952,904
1879	407,219	3,035,788	1,034,216	90	...	230,895	4,708,208	1,148,108	5,856,316
1880	444,253	3,316,484	944,869	...	...	201,297	4,906,903	1,227,252	6,134,155
1881	573,582	3,333,512	957,570	112,825	...	216,901	5,194,390	1,080,790	6,275,180
1882	526,522	3,458,440	785,868	85,354	...	187,337	5,043,521	1,002,720	6,046,241
1883	458,530	3,121,012	736,810	87,729	...	176,442	4,580,523	993,352	5,573,875
1884	396,059	3,114,472	1,062,471	93,404	...	160,404	4,826,810	921,797	5,748,607
1885	378,665	2,940,872	1,062,514	88,709	...	155,309	4,626,069	948,615	5,574,684
1886	366,294	2,660,784	1,187,189	95,674	1,148	117,250	4,428,339	903,569	5,331,908
1887	394,579	2,471,004	1,481,990	140,777	18,517	158,533	4,665,400	811,100	5,476,500
1888	317,241	2,500,104	1,690,477	69,007	13,273	147,154	4,737,256	801,066	5,538,322
1889	434,784	2,459,352	2,695,629	84,956	58,871	119,703	5,853,295	808,549	6,661,844
1890	460,285	2,354,240	2,182,563	101,577	86,664	75,888	5,261,217	773,438	6,034,655
1891	559,231	2,305,596	2,030,312	126,081	115,182	145,459	5,281,861	1,007,488	6,289,349
1892	575,299	2,617,824	2,164,391	135,755	226,284	158,917	5,878,470	954,744	6,833,214
1893	651,286	2,684,504	2,167,794	120,691	421,385	141,326	6,186,986	913,138	7,100,124
1894	1,156,717	2,867,816	2,330,282	143,100	787,099	217,024	7,502,338	887,839	8,389,877
1895	1,315,929	2,960,344	2,150,561	128,876	879,748	206,115	7,641,573	1,162,164	8,803,737
1896	1,073,360	3,220,348	2,132,979	95,560	1,068,808	237,574	7,828,629	1,041,428	8,870,057
1897	1,104,315	3,251,064	2,552,668	120,230	2,564,977	296,660	9,889,919	980,204	10,870,118
1898	1,201,743	3,349,028	2,750,348	95,465	3,990,698	291,946	11,678,778	1,080,691	12,759,469
1899	1,623,320	3,418,000	2,838,446	79,147	6,246,732	327,545	14,533,190	1,513,173	16,046,363
1900	1,070,920	3,229,628	2,871,578	82,482	6,007,610	316,220	13,578,438	1,439,602	15,018,040
1901	737,164	3,102,753	2,541,764	93,222	7,235,653	295,176	14,005,732	1,753,783	15,759,515
1902	684,970	3,062,028	2,720,512	95,203	7,947,662	301,573	14,811,948	1,951,433	16,763,381
1903	1,080,029	3,259,482	2,839,801	90,250	8,770,719	254,403	16,294,684	2,037,881	18,332,515
1904	1,146,109	3,325,045	2,714,934	80,008	8,424,226	280,015	15,897,337	1,987,501	17,884,838
1905	1,165,013	3,173,744	2,517,295	76,824	8,305,654	312,380	15,550,910	2,093,996	17,644,846
1906	1,078,866	3,280,478	2,313,464	81,225	7,622,749	254,963	14,631,745	2,270,904	16,902,649
1907	1,050,730	2,954,617	1,978,938	42,468	7,210,749	277,607	13,515,109	2,027,490	15,542,599
Total	£ 55,364,882	£ 279,471,595	£ 66,313,841	£ 2,749,609	£ 78,004,408	£ 6,523,821	£ 488,428,156	£ 71,528,978	£ 559,957,134

3. **Changes in Relative Positions of States as Gold Producers.**—A glance at the figures in the preceding table will sufficiently explain the enormous increase in the population of Victoria during the period 1851 to 1861, when an average of over 40,000 persons reached that State each year. Victoria maintained its position as the chief gold-producer for a period of forty-seven years, or up to 1898, when its production was first outstripped by that of Western Australia, the latter State from this year onward contributing practically half the entire yield of the Commonwealth. New South Wales occupied the second place on the list until 1876, when Queensland returns exceeded those of the parent State, a condition of things that has been maintained ever since. Up to the year 1884 Tasmania and South Australia in turn occupied the position of lowest contributor to the total gold yield of the Commonwealth, but from 1894 onwards the returns from the former State have been in excess of those of the latter. Taking the average of the last seven years the relative positions of each State and of New Zealand in regard to the gold production of Australia were, as follows:—

RELATIVE POSITIONS OF STATES AS GOLD PRODUCERS, 1901 to 1907.

State.	Annual Average of Gold Production, 1901 to 1907.	Percentage on Commonwealth.	State.	Annual Average of Gold Production, 1901 to 1907.	Percentage on Commonwealth.
Commonwealth ...	£	100.00	New Zealand ...	2,017,554	11.89*
Western Australia	7,981,059	53.02	New South Wales	991,840	6.63
Victoria ...	3,155,021	21.09	Tasmania ...	282,302	1.89
Queensland ...	2,518,101	16.84	South Australia	79,886	0.53

* Percentage on production of Australasia.

4. **Methods of Gold Mining adopted in Each State.**—The circumstances of gold mining in the various States are not quite identical, for which reason reference is made to that of each State.

(i.) *New South Wales.* In New South Wales the earlier "rushes" were to surface alluvial or shallow-sinking grounds. Many of these were apparently soon worked out, but there is reason to believe that in some instances payable results would be obtained by treating the rejected wash-dirt on more scientific principles. With the exhaustion of the surface deposits discoveries were made by sinking to what are called deep alluvial leads, representing the beds of old drainage channels in Pliocene times. The first of these deep alluvial leads was discovered at Forbes, in New South Wales, in 1862. The Tertiary deep leads at Gulgong were discovered in 1871. Cretaceous leads occur at Tibooburra, and detrital gold has been found in Permo-carboniferous conglomerates at Tallawang. The method of dredging is at present being extensively used for winning gold from the beds of running streams, and also in loose river flats and other wet ground where sinking would be impracticable. The system was introduced from New Zealand, where it was originally applied with great success on the Clutha River, and there are now dredges working on practically all the auriferous rivers of New South Wales. Hydraulic sluicing is also employed in several places, the necessary machinery being fitted to a pontoon for convenience in moving from place to place. The quantity of alluvial gold obtained, other than by dredging, amounted to 16,540 ozs. in 1907, the chief yields being—Braidwood, 1442 ozs.; Adelong, 1247 ozs.; Batlow, 1027 ozs.; Stuart Town, 978 ozs.; Wattle Flat, 900 ozs. The quantity obtained by dredging was 39,946 ozs., the largest returns being obtained at Adelong, with 11,786 ozs.; Araluen, 11,523 ozs.; Stuart Town, 7198 ozs.; Wellington, 3212 ozs.; and Sofala, 2331 ozs. At the present time the Cobar district is the chief centre of the production from quartz, the yields from the Canbelego and Cobar fields included therein being respectively 31,464 ozs. and 26,935 ozs. Next comes the Wyalong field, with 20,347 ozs.; Wellington, with 12,260 ozs.; Hillgrove, with 11,777 ozs.; and Murrumburrah, 9879 ozs.

The table below shews the yield from alluvial and quartz working in each of the principal districts during 1907 :—

GOLD WON IN NEW SOUTH WALES, ALLUVIAL AND QUARTZ, 1907.

District.	Alluvial.		Quartz.	Total
	Other than by Dredging.	By Dredging.		
	ozs.	ozs.	ozs.	ozs.
Bathurst	2,678	...	12,609	15,287
Cobar ... ..	...	...	58,464	58,464
Lachlan	811	...	36,951	37,762
Mudgee	2,289	3,212	21,204	26,705
Peel and Uralla	1,782	1,348	12,950	16,080
Southern	2,324	12,803	9,556	24,683
Tambaroora and Turon	1,505	9,529	790	11,824
Tumut and Adelong	4,317	13,053	1,469	18,839
Other districts	834	1	3,005	3,840

(ii.) *Victoria.* Quartz-reefing predominates in Victoria, although a considerable amount of gold is obtained from alluvial workings, both surface and deep leads. The deepest mines in Australia are found in the Bendigo district, where two shafts were at the 31st December, 1907, 4318 and 4300 feet deep respectively. Altogether there were at the close of 1907 no less than thirty-one shafts in this district which had reached a depth of over 3000 feet, while the bottom of the winze at the Victoria Reef Quartz was 4363 feet from the surface. A considerable amount of attention is given to dredging and hydraulic sluicing, particularly in the Beechworth, Castlemaine, and Ballarat districts, the number of plants in operation at the end of 1907 being 133. The yields from alluvial and quartz in the chief mining districts of the State during last year were as follows :—

GOLD WON IN VICTORIA, ALLUVIAL AND QUARTZ, 1907.

District.	Alluvial.	Quartz.	Total.
	ozs.	ozs.	ozs.
Ararat and Stawell	9,093	12,178	21,271
Ballarat	41,286	106,782	148,068
Beechworth	104,007	25,255	129,262
Bendigo	18,696	177,768	196,464
Castlemaine	38,446	63,944	102,390
Gippsland	8,467	66,715	75,182
Maryborough	47,835	33,366	81,201

(iii.) *Queensland.* Operations in Queensland are at present chiefly confined to quartz reefing, the yield from alluvial in 1907 being only about 9000 ozs. out of a total production of 465,900 ozs. The celebrated Mount Morgan mine occupies the position of being at the same time the most productive gold mine and the most productive copper mine in the State. The yields from the principal fields are given below :—

GOLD WON IN QUEENSLAND, ALLUVIAL AND QUARTZ, 1907.

District.	Alluvial.	Quartz.	Total.
	ozs.	ozs.	ozs.
Charters Towers	846	174,706	175,552
Gympie	466	63,761	64,227
Mount Morgan	354	145,420	145,774
Ravenswood	364	34,466	34,830
Croydon ... ..	...	13,411	13,411
Clermont	4,364	421	4,785
Etheridge and Woolgar	812	7,290	8,102
Other districts	2,127	17,074	19,201

(iv.) *South Australia.* In South Australia alluvial gold has been worked for many years in the gullies round Adelaide, while a fair amount of gold has been obtained by this method at Teetulpa, in the northern areas. There are some valuable reefing fields in the Echunga district, at Mt. Grainger, Barossa, Wadnaminga, Mannahill, etc., but they have not been developed to the extent they deserve. Good stone was discovered a few years ago at Tarcoola, but the present returns are comparatively small. The rich finds at Arltunga in the centre of the continent, within the boundaries of the Northern Territory, have not yielded up to expectations, but the field has not been systematically prospected. It is stated that the gold occurs chiefly in vughs, crevices, and cellular quartz, the latter being at times exceedingly rich. The solid stone is low grade and is not worked. Operations are confined to the vein matter, which is passed through screens, and the larger lumps hand picked, the fines and all that contains vughs or cellular quartz being saved for treatment and the balance discarded. The official returns shew that there were forty gold-dredging leases in existence last year. South Australia is not divided into mining districts as is the case in the other States.

(v.) *Western Australia.* In Western Australia the operations are confined principally to quartz reefing, the returns from ordinary alluvial and hydraulic sluicing being comparatively small. The total production of gold from all sources during last year was 1,697,554 ounces, of which only 0.6 per cent. was alluvial. The production from the more important mines was as follows:—

GOLD WON IN WESTERN AUSTRALIA, ALLUVIAL AND QUARTZ, 1907.

District.	Alluvial.	Dollied and Specimens.	Crushed.	Total.
	ozs.	ozs.	ozs.	ozs.
Peak Hill	119	80	7,912	8,111
East Murchison	259	89	118,860	119,208
Murchison	1,021	530	167,846	169,397
Mount Margaret	231	341	168,894	169,466
North Coolgardie	103	278	86,410	86,791
North-east Coolgardie	1,432	799	32,900	35,131
East Coolgardie	3,658	1,836	931,744	937,238
Coolgardie	220	925	59,665	60,810
Yilgarn ... ..	...	28	19,264	19,292
Dundas	73	80	23,449	23,602
Broad Arrow	660	171	21,077	21,908
Other districts	1,863	117	19,059	21,039

(vi.) *Tasmania.* The yield from Tasmania is also chiefly obtained from quartz reefing, although there is a little alluvial mining carried on in the Lyell district. The yields from the chief centres in 1907 are shewn hereunder:—

GOLD WON IN TASMANIA, ALLUVIAL AND QUARTZ, 1907.

	Northern & Southern.	North-eastern.	Eastern.	Western.	Total.
	ozs.	ozs.	ozs.	ozs.	ozs.
Quartz	34,674	325	4,986	24,574	64,559
Alluvial	475	242	33	45	795

The total production equalled 65,354 fine ounces, valued at £277,607.

(vii.) *New Zealand.* The yield of gold in New Zealand during 1907 was £2,027,490, of which quartz mining was responsible for £1,544,572, dredging £419,634, and alluvial £63,284. Of the total yield from quartz the Northern district returned £1,375,035, the West Coast £160,533, and the Southern £9004. The principal quartz mines are situated in the Ohinemuri and Thames counties. On the Waihi and Karangahake the veins give every indication of permanency. The Waihi is the most productive gold mine

in Australasia, and during 1907, from a total of 356,974 tons of quartz, gave a yield valued at £826,010. The company paid in dividends during 1907 the sum of £396,726. In the Thames district the Waiotahi produced 11,562 tons of ore during the year, averaging £12 19s. 2d. per ton, and declared a dividend of £117,000. The Progress mines were the chief producers in the South Island during 1907, their output of bullion being £87,805. New Zealand may be considered as the pioneer of dredge-mining in Australia, although the supply from this source is annually falling off owing to the depletion of suitable areas. In the West Coast and Southern districts 128 dredges were at work in 1907, producing, as previously stated, £419,634 worth of gold. The production from alluvial was £63,284, the greater portion being obtained in the Otago and Southland districts. Hydraulic sluicing, or sluicing and elevating, are the methods employed in working the deposits, but the long-continued dry weather in 1907 caused a great falling off in production as compared with the previous year.

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

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

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

6. Modes of Occurrence of Gold in Australia.—(i.) *New South Wales.* The principal gold deposits worked with profit in New South Wales are classified by the Government Geologist of that State as follows:—1. Alluvial or detrital gold. 2. Auriferous reefs or lodes. 3. Impregnations in stratified deposits, such as slate, quartzite, and volcanic tuff. 4. Impregnations in igneous rocks, such as granite, serpentine, felsite, etc. 5. Irregular deposits, such as bunches of auriferous ironstone. The detrital gold is found chiefly in Recent and Pleistocene alluvials, in beach sands along the coast, in Tertiary alluvial leads, in Cretaceous alluvial leads, and in Permo-carboniferous conglomerates. In the beach sands the gold is found in association with platinum and tin. In reefs the gangue is principally composed of quartz; calcide is often present, and barytes and fluor-spar are also met with. At Hill End gold was found associated with muscovite. In the oxidised portions of auriferous reefs, limonite, malachite, azurite, and cuprite are found, while below the water-line the veins are impregnated with iron pyrites, galena, copper pyrites, zinc blende, pyrrhotine, and stibnite. The auriferous quartz veins fall into three categories—fissure veins, bedded veins, and contact veins. Large masses of gold have occasionally been found in lodes, such as "Kerr's Hundredweight," alluded to in a preceding paragraph. The so-called saddle reefs in the Hargraves district are identical with those worked so profitably and at such great depths round Bendigo, in Victoria. Altogether gold has been found in association with over forty minerals in New South Wales, one of the most peculiar products being known as "mustard" gold, resultant on the decomposition of tellurides. The substance has the appearance of dull yellow clay; but it readily burnishes when pressed with a knife blade. Native gold has never been found in an absolutely pure state in New South Wales, being always alloyed with silver and also traces of other metals.

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

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

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

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

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

7. **Place of Commonwealth in the World's Gold Production.**—In the table given below will be found the estimated value of the world's gold production, and the share of the Commonwealth therein during the ten years 1897 to 1906. The figures given in the table have been compiled from returns obtained direct by the Commonwealth Bureau of Census and Statistics from the gold-producing countries of the world.

WORLD'S GOLD PRODUCTION, 1897 to 1906.

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

The latest published estimates place the world's gold yield at about 82½ millions sterling in 1907, towards which the Commonwealth contributed 13½ millions, or about 16½ per cent. While the production of gold in the Commonwealth rose by about 48 per cent. in the decennium 1897-1906, the world's total increased by over 71 per cent. in the same period. The following table, which has been compiled from official returns forwarded to this Bureau, will be found interesting as shewing the various foreign countries where the chief increases have taken place during the interval in question:—

INCREASE IN GOLD YIELD, VARIOUS COUNTRIES, 1897 to 1906.

Country.	1897.	1900	1903	1906.
	£	£	£	£
United States	11,787,000	16,269,000	15,122,000	19,392,000
Canada	1,240,000	5,742,000	3,877,000	2,365,000
Mexico	2,045,000	1,122,000	2,197,000	3,424,000
Transvaal	11,654,000	1,481,000	12,628,000	24,606,000
Rhodesia	800	308,000	828,000	1,985,000
Gold Coast	85,000	38,000	255,000	322,000
Madagascar	8,500	142,000	232,000	268,000
India	1,571,000	1,893,000	2,303,000	2,230,000
Korea	208,000	371,000	557,000	476,000
Japan	142,000	290,000	428,000	926,000
Java	24,000	100,000	280,000	371,000
Costa Rica	2,000	14,000	7,000	28,000

The largest increase was recorded in the Transvaal, where the production practically doubled itself in the four years 1903 to 1906.

The number of persons engaged in gold mining in each State and New Zealand during the last six years is shewn in the following table. The figures for South Australia include 227 Chinese working on the fields in the Northern Territory.

PERSONS EMPLOYED IN GOLD MINING, 1901 to 1907.

State.	Persons Employed in Gold Mining.						
	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	No.	No.	No.	No.	No.	No.	No.
New South Wales ...	12,064	10,610	11,247	10,648	10,309	8,816	7,468
Victoria ...	27,777	26,151	25,208	24,331	25,369	25,304	23,291
Queensland ...	9,438	9,045	9,229	9,620	10,641	9,842	8,883
South Australia ...	1,000	1,000	1,000	1,000	900	900	914
Western Australia ...	19,771	20,476	20,716	18,804	18,382	17,926	17,237
Tasmania ...	1,112	1,038	973	1,076	1,207	988	953
Commonwealth ...	71,162	68,320	68,373	65,479	66,808	63,776	58,746
New Zealand ...	12,732	11,398	10,210	10,898	9,362	9,039	9,138

§ 3. Platinum and the Platinoid Metals.

1. **Platinum.**—The existence of platinum was first noted in New South Wales in 1851 by Mr. S. Stutchbury, who found a small quantity near Orange. Since the year 1878 small quantities of the metal have been obtained from beach sands in the northern coastal district. Platiniferous ore was noted in 1889 at Broken Hill. The chief deposits at present worked in the State are situated at Fifield, near Parkes, but the entire production last year was small, amounting to only 276 ozs., valued at £1014.

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

2. **Osmium, Iridium, etc.**—Small quantities of osmium, iridium, and rhodium are also found in various localities. As far back as 1860, the Rev. W. B. Clarke states that he found native iridium. Platinum, associated with iridium and osmium, has been found in the washings from the Aberfoil River, about 15 miles from Oban, on the beach sands of the northern coast; in the gem sand at Bingara, Mudgee, Bathurst, and other places. In some cases, as for example in the beach sands of Ballina, the osmiridium and other platinoid metals amount to as much as 40 per cent. of the platinum, or about 28 per cent. of the whole metallic content.

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

§ 4. Silver.

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

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

Mining for silver is not carried on to any extent in Victoria, the production recorded in the mining returns being chiefly obtained in the process of refining gold, and the same applies in the case of the production from Western Australia. In Queensland most of the important gold mines yield also supplies of silver, but the credit of establishing the silver mining industry *per se* belongs to the Ravenswood field, where in 1879 the recovery of a parcel of 40 tons of galena assaying 130 ozs. of silver to the ton, marked the opening of the industry. At Chillagoe in 1884 there were thirty-two silver lead shows being worked, while during the decade 1885-1895 over 1½ million ozs. were raised at the Mount Albion mine. The Lady Jane and Girofla mines in the Mungana group at present are producing large supplies of silver lead ore of high grade. The Silver Spur mine at Texas produced £11,500 worth of silver lead in 1894, and the ore deposits in the vicinity are reckoned to be the richest in Southern Queensland. In South Australia, silver lead is found in the main range, south of Adelaide. The Wheal Gawler mine, near Glen Osmond, opened in 1841, was probably the first mine worked in the Commonwealth. Silver lead deposits have also been noted north-east from Farina and west from Beltana. The production of both silver and lead in 1907 was only about £700. A small amount of silver lead is also obtained in the Northern Territory, the production in 1907 being valued at £4164. Tasmania is the only other State in the Commonwealth which produces any considerable quantity of silver. The famous Zeehan mine, on the west coast, was discovered in 1885, and the deposits at Heazlewood River in 1887. Both districts are still opening up rich deposits of ore. In New Zealand, and particularly in the North Island, the gold generally contains a large proportion of silver, but the rich deposits of argenteriferous ores at Puhupuhi, Collingwood, Mount Rangitoto, and other places have not yet been systematically exploited.

2. **Development of Silver Mining.**—In illustration of the great development of silver mining in Australia the following table has been compiled, shewing the production of silver, silver lead and ore, and lead from each State during the years 1881, 1891, and 1901 to 1907:—

PRODUCTION OF SILVER AND LEAD, AUSTRALASIA, 1881 to 1907.

State.	Silver, Silver Lead Ore, Lead, etc., produced during								
	1881.	1891.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	£	£	£	£	£	£	£	£	£
N. S. W. ...	...	3,621,614	1,954,964	1,487,837	1,539,969	2,131,504	2,496,709	2,564,057	4,290,128
Victoria ...	5,239	6,017	6,550	4,900	4,898	4,990	4,100	4,980	4,355
Queensland ...	13,494	21,879	69,234	72,851	109,177	96,418	102,368	151,577	187,870
South Australia ...	1,182	5,927	3,866	42,063	10,870	1,387	3,244	12,982	13,873
West. Australia ...	11,224	250	7,718	9,467	19,153	45,912	44,278	37,612	26,674
Tasmania ...	...	62,138	325,335	387,024	426,125	318,971	415,248	552,704	572,560
Commonwealth	31,139	3,717,625	2,367,687	2,004,142	2,112,212	2,599,182	3,065,967	3,623,912	5,095,460
New Zealand ...	4,236	5,151	65,258	71,975	91,497	112,875	120,542	143,372	163,484

The figures quoted for New South Wales in the above table represent the *net* value of the product (excluding zinc) of the silver-lead mines of the State, and clearly show the great progress made by this branch of the mining industry during the last quinquennium. In explanation of the values thus given, it must be noted that the metallic contents of the larger portion of the output from the silver-lead mines in the State is extracted outside New South Wales, and it is considered, therefore, that the State should not take full credit for the finished product. Hence the *net* value referred to above refers to that of the ore, concentrates, and bullion, as declared by the several companies

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

**VALUE OF PRODUCTION FROM SILVER-LEAD MINES OF NEW SOUTH WALES,
1903 TO 1907.**

Year.	Value of Silver, Lead, and Spelter produced within the C'wealth.	Value of Concentrates Exported	Total.
	£	£	£
1908	1,790,929	308,714	2,099,643
1904	2,088,784	642,125	2,730,909
1905	2,131,317	1,181,720	3,313,037
1906	2,112,977	1,876,834	3,989,811
1907	2,228,420	3,574,775	5,803,195

3. Chief Centres of Silver Production.—Broken Hill, in New South Wales, and Zeehan, in Tasmania, are the great centres of silver production in Australasia. The production in Queensland has, however, considerably expanded during the last few years.

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

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

Although the returns are not complete in all cases, the following table relating to the mines at Broken Hill will give some idea of the richness of the field:—

RETURNS OF BROKEN HILL SILVER MINES, 1907.

Mine.	Authorised Capital.	Value of Output to end of 1907.	Dividends and Bonuses Paid to end of 1907.
	£	£	£
Broken Hill Proprietary Co. Ltd. ...	384,000	30,966,293	11,424,000
Broken Hill Proprietary Block 14 Co. ...	155,000	3,104,253	430,827
British Broken Hill Proprietary Co. ...	264,000	1,993,616	337,500
Broken Hill Proprietary Block 10 Co. ...	1,000,000	3,242,781	1,155,000
Sulphide Corporation Ltd. (Central Mine) ...	1,100,000	7,727,887*	501,875*
Broken Hill South Silver Mining Co. ...	200,000	2,767,650	575,000
North Broken Hill Mining Co. ...	140,000	625,893*	172,440
Broken Hill Junction Mining Co. ...	100,000	797,673*	85,000
Broken Hill Junction North Silver Mining Co. ...	180,000	336,219*	25,793
Broken Hill South Blocks Ltd. ...	200,000	197,806	...
Broken Hill South Extended Ltd. ...	337,500	150,344	50,000
Totals ...	4,060,500	51,910,415*	14,757,435

* Incomplete.

(ii.) *Yerranderie and Conrad Stannite.* The mines on the Yerranderie field in the Southern Mining District produced 479,000 ozs. of silver in 1907, besides small quantities of gold and lead. The total production was valued at £80,000, as compared with £9000 in 1900. During 1907 the Conrad Stannite Mines Ltd., at Howell, in the Tingha Division, raised 38,800 tons of ore, valued at £81,097.

(iii.) *West Coast of Tasmania.* The silver-lead mines on the west coast are now well established. Amongst the most important are the Mt. Zeehan, Zeehan-Montana, Zeehan-Western, Florence, Oonah, Silver Queen Extended, and South Comstock. The total production of silver-lead ore in 1907 was 89,762 tons, valued at £572,560.

(iv.) In Queensland the two great Mungana mines, the Lady Jane and Girofla, produced in 1907, £34,027 worth of copper, £22,307 worth of silver, and £30,978 worth of lead. The Silver Spur mine at Texas produced £25,749 worth of metals, chiefly silver and lead. It is believed that silver lead will also prove an important factor in the development of the Etheridge goldfield.

The effect of the improved treatment of refractory ores is seen particularly in the returns for the Broken Hill district of New South Wales, where the export of zinc spelter and concentrates has increased from 97 tons valued at £988 in 1889, to 237,219 tons valued at £536,620 in 1907. In addition to the numerous plants for dealing with refractory ores on the fields itself, the Broken Hill Company possesses extensive smelting works at Port Pirie in South Australia. At Dapto and Cockle Creek in New South Wales there are also smelting establishments capable of dealing with considerable bodies of ore of various classes. The Tasmanian silver and lead ores are principally dealt with by the Tasmanian Smelting Company's works at Zeehan.

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

WORLD'S PRODUCTION OF SILVER, 1901 to 1907.

Year ...	1901.	1902.	1903.	1904.	1905.	1906.	1907.
World's production* in 1000 fine ozs. ...	174,851	163,937	173,222	176,840	181,338	185,035	193,542

* Add 000 to figures for fine ounces.

The Commonwealth's share in the world's silver production averages about 13 per cent.

5. **Prices of Silver.**—As the production of silver is dependent to a very large extent on the price realised, a statement of the average price per standard ounce paid by the London Mint at various periods and during the last six years is given below.

PRICES OF SILVER, 1871 to 1907.

Year	1871.	1881.	1891.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Pence per standard oz.	60 $\frac{7}{16}$	51 $\frac{1}{8}$	45 $\frac{5}{16}$	27 $\frac{1}{8}$	24 $\frac{5}{16}$	23 $\frac{1}{8}$	26 $\frac{1}{2}$	27 $\frac{7}{16}$	31 $\frac{1}{16}$	30 $\frac{9}{16}$

During the month of November, 1906, owing to the small sales in New York, and also to the fact that the Indian, American, and Mexican Governments were all buying silver, the price rose to 33 $\frac{1}{2}$ d., the highest realised since 1893, when the average stood at 36 $\frac{1}{16}$ d.

6. **Employment in Silver Mining.**—The number of persons employed in silver mining during each year of the period 1901 to 1907 is given below :—

PERSONS EMPLOYED IN SILVER MINING, 1901 to 1907.

State.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
N.S.W. ...	6,298	5,382	6,035	7,071	7,887	9,414	10,021
Victoria ...	...	...	...	...	...	13	10
Queensland ...	40	100	458	45	293	282	785
South Australia	150	150	150	50	50	50	86
West. Australia	...	...	...	...	...	...	8
Tasmania ...	2,414	2,893	1,681	1,101	1,512	1,745	1,908
Commonwealth	8,902	8,525	8,324	8,267	9,742	11,504	12,818

As the table shews, the bulk of the employment was in New South Wales and Tasmania, the quantity of silver raised in the other States, excepting Queensland, being unimportant.

§ 5. Copper.

1. **History.**—(i.) *New South Wales.* It is believed that copper was the first metal mined for in New South Wales, the earliest attempts at working taking place about the year 1844. The deposits at Copper Hill, near Molong, were worked in 1845, as well as those in the neighbourhood of Canowindra. In 1847 mining for copper was commenced at the Summerhill Estate, near Rockley. The Rev. W. B. Clarke reported the discovery of copper ores near Marulan in 1851, and at Quidong, in the Snowy River district, in 1852. The principal seat of the copper-mining industry at the present date is in the Cobar district, the value of the deposits there being first recognised in 1869. The Mount Hope field was opened in 1878, Nymagee 1880, and Lake George in 1882.

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

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

(iii.) *Queensland.* The first important discovery of copper in Queensland was made in the year 1862, when a rich lode was found near Clermont, on the Peak Downs. A

further discovery was made during the same year at Mount Perry. Copper, tin, silver, and gold were found on the Herberton, Walsh, and Tinaroo mineral fields in 1879. The famous Mount Morgan, discovered in 1882, also produces a considerable amount of copper, the production therefrom in 1907 exceeding that from any other district. The production in 1907 from the more important districts was as follows:—Mount Morgan, £386,000; Herberton, £314,000; Mount Perry, £170,000; Cloncurry, £55,000; Gladstone, £42,000.

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

Yorke's Peninsula, between Spencer's Gulf and St. Vincent's Gulf, contains a large area of copper-bearing country. The principal mines at Wallaroo and Moonta are situated a few miles from Port Wallaroo, and date back to 1860. For about thirty years the Moonta mines were worked independently, selling their ores to the Wallaroo company. During its separate existence the Wallaroo field produced about £2,600,000 worth of copper, while Moonta yielded £5,396,000, and was the first Australian mining field to produce £1,000,000 in dividends. The amalgamation took place in 1889, and since that year the united properties have produced about £4,281,000 worth of copper. The entire yield from the date of first working is estimated at about £12,500,000. On the 30th. June, 1907, the number of employees was stated as 3107. The mines just enumerated represent a very small proportion only of those opened on the copper bearing areas of the State. The latest returns shew that at Mutooroo near the New South Wales border, 100 men are employed in mining for copper, while work is proceeding at Yudnamutana, the Daly mine, and some of the old mines to the south of Adelaide.

Copper is also obtained in the Northern Territory, the production being chiefly from the mines of the Northern Territories Mining and Smelting Co. Ltd. at Yam Creek.

(v.) *Western Australia.* The inception of active mining operations in Western Australia dates from the year 1842, when lead and copper mines were discovered in the Northampton district, but working was carried on in a most perfunctory manner in the early days, sinking being discontinued as soon as the lodes shewed signs of contraction. Rich ores of copper have been located at Whim Creek, in the Pilbara district, about fifty miles eastward of Roeburne, the copper ore being removed by quarrying. Promising lodes have also been struck at the Irwin mines, between Arrino Springs and the Irwin River. The Kimberley district is intersected in places by copper and lead deposits in association with gold, and a rich lode has been located at Mount Barren, about 120 miles to the eastward of Albany, while various quartz reefs in the Wongan Hills contain copper in association with gold and iron. The West Pilbara field, from which there was no production in 1906, yielded £63,000 worth of copper ore in 1907. From the mines at Eulaminna in the Mount Morgans district, the yield was £59,000 and the Phillips River fields shewed a total output of £57,000.

(vi.) *Tasmania.* For a long time Tasmania was the largest producer of copper in the Commonwealth, but during the last two years Queensland has occupied the premier position. The cupriferosus area in the island State stretches from Mount Lyell, Mount Tyndall, Mount Read, and Mount Murchison, in the western district, to some distance north of the Pieman River. Copper mining has also been started on the North-west Coast, notably in the Stowport and Blythe River districts, and some attention has been given to the deposits at Rocky Cape and Boat Harbour. In 1907 the output of the Mount Lyell Mining and Railway Co. Ltd. was 8247 tons of blister copper, which contained copper valued at £745,253, silver £87,438, and gold £81,876.

(vii.) *New Zealand.* Copper ore has been found and worked in different localities in New Zealand, but in a desultory fashion only, the export in 1907 being 56 tons, valued at £595.

2. **Production of Copper.**—The production of copper during the years 1901 to 1907 in the various States of the Commonwealth has been influenced considerably by the ruling prices, which have fluctuated in an extraordinary way. The value of the production in earlier years and for 1901 to 1907 is shewn in the following tables :—

VALUE OF PRODUCTION OF COPPER, AUSTRALASIA, 1881 to 1907.

State.	1881.	1891.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	£	£	£	£	£	£	£	£	£
N.S.W. ...	267,884	119,195	412,292	307,806	462,640	406,001	527,403	789,527	727,774
Victoria	8,186	216	...	...	500	...	...	...	2,356
Q'land ...	19,637	865	194,227	189,200	285,122	257,896	503,547	916,546	1,028,179
S. Aust. ...	418,296	239,436	500,077	432,525	472,033	438,960	483,431	743,671	705,031
W. Aust. ...	...	4,463	75,246	8,090	56,541	25,180	16,266	50,337	180,387
Tasmania	...	...	1,026,748	710,146	511,801	569,053	563,275	844,663	869,665
C'wealth	714,003	364,175	2,208,590	1,647,767	1,788,697	1,697,090	2,093,922	3,344,744	3,513,393
N.Z. ...	36	4	105	...	123	...	17	...	595

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

FLUCTUATION IN THE VALUE OF COPPER, 1897 to 1908.

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

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

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

WORLD'S PRODUCTION OF COPPER, 1901 to 1907.

Year	1901.	1902.	1903.	1904.	1905.	1906.	1907.
World's production (short tons)	586,712	597,805	664,644	731,342	771,239	788,890	798,023

Of the total production last year the share of the Commonwealth amounted to about 6 per cent.

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

PERSONS ENGAGED IN COPPER MINING, 1901 to 1907.

State.	Persons Engaged in Copper Mining.						
	1901.	1902.	1903.	1904.	1905.	1906.	1907.
N.S.W.	2,964	1,699	1,816	1,850	2,171	3,047	3,764
Victoria	4	...	...	...	...	3	10
Queensland	814	666	1,418	1,094	1,435	2,598	3,941
South Australia	4,000	4,000	4,000	4,000	4,500	5,000	5,254
West. Australia	321	113	193	169	125	296	611
Tasmania	*	*	*	925	2,269	2,391	2,614
Commonwealth	8,103	6,478	7,427	8,038	10,500	13,335	16,194

* Included with silver miners.

There were 112 persons engaged in mining for copper during 1907 in New Zealand.

§ 6. Tin.

1. **History.**—(i.) *New South Wales.* The probable occurrence of tin in New South Wales was first referred to by the Rev. W. B. Clarke as early as 1849, while the same author notes having obtained a specimen in the Kosciusko district in 1851 and in the New England district in 1853. He also reported the discovery of stanniferous deposits at different localities in the Darling Downs, Queensland. In 1872 the Messrs. Fearby discovered tinstone near Inverell, and the present Elsmore mine was opened near the spot. The news of the discovery of tin in the New England district attracted a mild rush, and in March, 1872, valuable deposits of stream tin were found at Vegetable Creek. It is interesting to note that native tin, which is extremely rare, was discovered at Oban, in this district. At Cope's Creek stanniferous gravels occur in the channel of the stream and in the slopes adjacent to it. Post-tertiary deposits of tin-bearing ore have been found at Emmaville, where mining was commenced soon after the opening of the district. In the southern portion of the State deposits have been discovered at Dora Dora, near Albury, and Pulletop, near Wagga, in the central-western district at Burra Burra, near Parkes, and in the far west at Poolamacca and Euriowie. The bulk of the yield, however, still comes from the Tingha-Inverell district, the production last year being £194,000 out of a total for the whole State of £293,000. Of the total production in 1907 £176,212, or 60 per cent., represents the value obtained by dredging.

(ii.) *Victoria.* In Victoria lode tin has been discovered at Mt. Wills, Beechworth, Eldorado, Chiltern, Stanley, and other places in the north-eastern district; and stream tin has been found in a large number of places, including those just mentioned in the north-eastern district. The bulk of the production last year was obtained by dredging and hydraulic sluicing, the chief yields being 36 tons of ore, valued at £3721, raised by the Cock's Pioneer Dredging Company at Beechworth, and 27 tons, valued at £2903, raised by the Franklin River Hydraulic Sluicing Company at Toora.

(iii.) *Queensland.* The first notable discovery of the metal in Queensland occurred in 1872, when rich deposits of stream tin were found in the country to the south of Warwick and on the borders of New South Wales. This district proved to be surprisingly rich, the value of the metal raised there during the five years subsequent to its discovery being £715,000. The alluvial deposits, however, soon became exhausted, so far as the ordinary miner is concerned, but some degree of success has attended dredging operations in the district. In 1879 important discoveries were made in the Herbert River district, and the rich Herberton, Walsh, and Tinaroo mineral fields were opened up, further discoveries being shortly after reported on the Russell, Mulgrave, Jordan, and Johnstone. At the Annan River tinfield, near Cooktown, alluvial mining has been carried on continuously since 1886. The production in 1907 amounted to 5140 tons, valued at £496,766, more than three-fourths of which were produced by the Herberton mineral field.

(iv.) *Northern Territory.* Valuable lodes of tin are found in the Northern Territory at West Arm and Bynoe Harbour, and at Horseshoe Creek, south of Pine Creek, but the deposits have not yet been exploited to the extent they deserve.

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

(v.) *Western Australia.* Tin was first discovered in Western Australia in the year 1888, and since that date has been found in several widely distant localities in the State—at the head of the Bow and Lennard Rivers, in the Kimberley district; on the Thomas River, Gascoyne goldfield; at Brockman's Soak and the Western Shaw, in the Pilbara district; and at Greenbushes, in the south-western portion of the State. The production of tin for the State during 1907 amounted to 1624 tons, valued at £158,648, to which the Greenbushes field contributed 770 tons, valued at £73,045, and Pilbara 854 tons, valued at £85,603. Lode tin has been discovered at Wodgina, in the Pilbara field, and the deposits are being developed.

(vi.) *Tasmania.* Tin mining in Tasmania dates from the year 1871, when the celebrated Mount Bischoff mine was discovered by Mr. James Smith. This mine, which is probably the richest in existence, is worked as an open quarry, and a large proportion of the original hill has been removed in the course of developmental operations. Soon after rich deposits were located in the north-east district by Mr. G. B. Bell, while deposits of stream tin were discovered near St. Helens by Messrs. Wintle and Hunt. Further finds were reported from Flinders and Cape Barren Islands, and in 1875 the metal was discovered at Mount Heemskirk. The total production of Tasmania in 1907 was 4343 tons of ore, valued at £501,681, the largest producer being the Briseis Tin Mines Limited, in the North-East Division, with a return of 1017 tons. This company distributed during the year £112,500 in dividends. The Mount Bischoff mine paid dividends amounting to £36,000, making a total to the end of 1907 of £2,124,000. Good returns are being obtained at the North-East Dundas and at Mount Heemskirk, and a fair amount of alluvial is furnished by the Eastern mining division.

(vii.) *New Zealand.* In New Zealand tin ore has been found widely distributed among the gravel drifts in the neighbourhood of the Remarkables, in Stewart Island, but the deposits have up to the present not proved sufficiently rich to pay for working.

2. Value of Tin Produced.—The development of tin mining is, of course, largely dependent on the price realised for the metal, and, as in the case of copper, the production

has been subjected to somewhat violent fluctuations. The table below shews the production in each of the Commonwealth States during the years 1881, 1891, and 1901 to 1907. There is no record of production in New Zealand:—

TIN PRODUCED IN AUSTRALIA, 1881 to 1907.

State.	Value of Tin Produced in								
	1881.	1891.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	£	£	£	£	£	£	£	£	£
New South Wales ...	568,795	133,963	76,544	59,593	150,208	188,377	226,110	255,744	293,305
Victoria ...	7,334	5,092	4,181	500	2,165	5,190	11,159	11,644	10,531
Queensland ...	193,699	116,387	93,723	116,171	243,149	270,276	297,454	490,283	496,766
South Australia ...	...	1,938	5,586	6,078	10,773	24,179	23,768	36,907	41,365
West Australia ...	...	10,200	40,000	39,783	55,890	58,817	86,840	157,644	158,648
Tasmania ...	375,775	293,170	212,542	237,846	308,594	257,256	368,796	537,266	501,681
Commonwealth ...	1,145,603	560,750	432,576	459,971	770,779	804,095	1,014,127	1,509,488	1,502,296

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

THE WORLD'S TIN SUPPLIES, 1903 to 1907.

Origin.	1903.	1904.	1905.	1906.	1907.
	Tons.	Tons.	Tons.	Tons.	Tons.
English production ...	4,282	4,132	4,468	4,522	4,700
Chinese exports ...	...	...	4,482	4,052	4,000
Straits to Europe and America ...	52,212	57,419	56,840	57,143	52,520
Straits to India and China ...	3,123	3,261	1,484	1,292	3,140
Australia to Europe and America ...	4,934	4,846	5,028	6,482	6,612
Banka sales in Holland ...	15,070	11,363	9,960	9,286	11,264
Billiton sales in Java and Holland ...	3,650	3,215	2,715	1,968	2,229
Bolivian arrivals on Continent ...	9,630	12,978	14,245	16,394	15,500
Bolivian arrivals in England ...					
Total (long tons) ...	92,901	97,214	99,222	101,139	99,965

The main users of tin are the manufacturers of tin-plates, while it is also required in conjunction with other metals to produce bronze, brass, Britannia metal, pewter, printers' type, and solder. It is stated that the rising tendency of prices during recent years is due to the fact that production has not been commensurate with the demands for consumption, and also in some measure to the fact that for industrial purposes the metal can be replaced by others to a limited extent only.

4. **Prices of Tin.**—The average price of the metal in the London market for the year 1897 and from 1901 to 1907, was as follows:—

PRICE PER TON OF TIN, 1897 to 1907.

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

According to "The Mineral Industry" the maximum price obtained for tin during the period 1897-1907 was reached in December, 1906, when the metal was quoted at £195 19s. 9d. per ton.

5. **Employment in Tin Mining.**—The number of persons employed in tin mining during each of the years 1901 to 1907 is shewn below:—

PERSONS ENGAGED IN TIN MINING, 1901 to 1907.

State.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
New South Wales ...	1,428	1,288	2,502	2,745	2,884	3,795	3,173
Victoria ...	...	...	...	50	50	95	87
Queensland ...	1,148	1,467	1,598	2,237	2,936	2,872	2,582
South Australia ...	...	...	...	...	...	...	554
Western Australia ...	413	249	294	284	479	890	1,003
Tasmania ...	1,065	1,260	1,331	1,304	1,351	1,659	1,828
Commonwealth ...	4,054	4,264	5,725	6,620	7,700	9,311	9,227

§ 7. Zinc.

1. **Production of Zinc.**—The production of spelter is practically confined to the Broken Hill district of New South Wales, where zincblende forms one of the chief constituents in the enormous deposits of sulphide ores.

Improvements in means of extraction have led to a largely increased production in recent years as the following table shews:—

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

The average price of spelter per ton in the London market during the last three years was £25 8s. 8d. in 1905, £27 0s. 5d. in 1906, and £23 15s. 5d. in 1907.

§ 8. Iron.

1. **History.**—(i.) *New South Wales.* The existence of large deposits of iron ore in New South Wales has been known since the early years of the history of the State, but until quite recently little was accomplished in the way of utilising these deposits so as to produce any extensive supply of marketable metal. According to a report furnished by the Government Geologist in 1905, the total quantity of ore available for exploitation is 53,000,000 tons, the deposits at Cadia, near Orange, being computed to contain no less than 39,000,000 tons, of which a large proportion consists of ores capable of yielding a high-grade metal. The aluminous ores at Wingello are estimated to contain 3,000,000 tons, the titaniferous magnetic ores on the Williams and Karuah Rivers nearly 2,000,000 tons, the hematite and brown ores at Carcoar, 3,000,000 tons; while several other districts are capable of supplying over 1,000,000 tons. There are extensive supplies of

coal and limestone within reasonable distance of some of the more extensive deposits. The increasing demand for iron and steel manufactures and the enhanced price of the metal, will probably enable the State in the near future to take its place amongst the iron-producing countries of the world. Ironworks were established at Fitzroy, near Mittagong, as far back as 1852, and at Eskbank, near Lithgow, in 1875, but the production of pig iron and manufactures was in neither case considerable. In May, 1907, however, works on a much larger scale were opened at Lithgow, and their success for some time seemed practically assured, since the Government contracted with them for a supply of rails and other ironwork for a period of seven years. The ironstone used in this establishment was obtained at Carcoar, where the deposit is calculated to yield 2000 tons of ore for a period of twenty-five years. Coke was obtained in large quantities from the South Coast district, but it was proposed to obtain the main supply from the Oakey Park Coal Company, while the limestone was furnished by the Portland Cement Company. During 1907 the ore raised amounted to 34,731 tons. The following materials were also received at the blast furnace:—Limestone, 13,433 tons; coke, 20,873 tons; and slag, 2831 tons. The output was 18,631 tons of pig iron, valued at £60,550. In addition 11,271 tons of iron and steel, bars, castings, etc., valued at £118,082, were made from scrap, and 5700 tons of steel ingots, valued at £28,075, were made from pig iron and steel scrap. The mine and works employed 871 hands, and the wages paid amounted to £79,944. At date of writing this article operations were suspended.

(ii.) *Victoria.* Iron ore has been located at various places in Victoria, particularly at Nowa Nowa, in the Gippsland district, and at Dookie. In his report for 1905 the Secretary for Mines states that without special assistance to the industry there does not seem to be any prospect of the deposits being cheaply worked.

(iii.) *Queensland.* Queensland possesses some extensive deposits of iron ore, which is mined chiefly for fluxing purposes in connection with the reduction of gold and copper ores.

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

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

(v.) *Western Australia.* This State has some very rich deposits of iron ore, but owing to their geographical position the most extensive fields at the present time are practically unexploited, the production in the State being confined chiefly to that needed for fluxing purposes. The Murchison field possesses some extensive deposits of high-grade ore.

(vi.) *Tasmania.* The existence of large quantities of iron ore in Tasmania was noted as far back as 1822, when Surveyor-General Evans alluded to the "surprising abundance of iron within a few miles of Launceston." A company known as the Tasmanian Charcoal Iron Company was formed to work these deposits, and commenced operations in June, 1876. Unfortunately, however, the presence of chromium rendered the pig-iron so hard and brittle that the works had to be abandoned. Extensive deposits of specular iron ore are also found in the neighbourhood of the Blythe and Gawler Rivers.

(vii.) *New Zealand.* The deposits of iron ore in the Auckland, Otago, and Nelson districts have up to the present been little utilised, but it is proposed to float a company to exploit the rich hematite deposit at Parapara.

§ 9. Other Metals.

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

2. **Antimony.**—This metal is widely distributed in New South Wales, and has been found native at Lucknow, near Orange. Dyscrasite, a silver antimonide, has been found in masses up to one ton in weight in the Broken Hill lodes. It has also been found at various places in Victoria, chiefly in association with gold. In 1906 the export of antimony metal and ore from New South Wales amounted to £52,645, and in 1907 to £46,278. The chief production in 1907 was from the Hillgrove district, and amounted to £22,372. The production of antimony ore in Victoria during 1907 amounted to 4500 tons, valued at £13,290. The ore was raised by two syndicates operating at Costerfield. In New Zealand the metal has been found associated with gold and silver in quartz lodes at Puhipuhi, Thames, and Te Aroha, in the Auckland district, and at Rēefton, Langdons, and the west coast of Middle Island, as well as at several localities in the Otago district. An extensive lode was at one time worked at Endeavour Inlet, and a good sulphide lode at Collingwood. Extensive deposits were discovered at Neerdie, in the Wide Bay district of Queensland, during 1872, also at Wolfram Camp on the Hodgkisson field, on the Palmer River, and in the Ravenswood district. In 1907 the yield from the Hodgkisson mines was valued at £6356, while ore to the value of £550 was raised at Ravenswood. In Western Australia good lodes of stibnite, carrying gold, have been found in the Roeburne district.

3. **Arsenic.**—In the form of arsenopyrite, arsenic is of wide distribution in Victoria, but the deposits are worked to a limited extent only. At Ballarat a small quantity of the oxide is obtained from the flues of roasting furnaces.

4. **Barium.**—A valuable lode of barium sulphate has been discovered near Dalwin, on the North Lyell railway, in Tasmania, and the necessary plant is in course of erection to develop the deposit. It is stated that the lode is from 2½ to 7 feet wide over a length of over 40 chains.

5. **Bismuth.**—This metal has been found in New South Wales, near Glen Innes, and also in the vicinity of Pambula, its discovery dating from 1877. About seventeen tons of metal and ore were exported during 1907. In Queensland the metal is found in the Hodgkisson and Herberton districts, at Ukalunda in the Ravenswood district, and at Biggenden, in the Burnett district. The production in 1907 was valued at £1806. In South Australia deposits are found at Balhannah, at Mount MacDonald, and at Winninnie, on the shores of Spencer's Gulf. Small quantities are also produced in Tasmania.

6. **Chromium.**—In New South Wales chromium is found at Bowling Alley Point, on the Peel River, and also near Coolac, but the quantity raised at present is insignificant. The metal is also found in the Nelson district in New Zealand.

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

8. **Cobalt.**—This metal was found at Carcoar in New South Wales in 1888, and subsequently at Bungonia, Port Macquarie, and various other places. Deposits have been noted in South Australia near Bimbourie, and South Blinman, in Western Australia at Norseman and Kanowna, and at various places in Victoria.

9. **Lead.**—This metal was first noted in New South Wales in 1849, when small specimens of native metal were found by the Rev. W. B. Clarke. At present lead mining *per se* is not practised to any extent in the Commonwealth, the supply of the metal being

chiefly obtained in conjunction with silver. In Victoria oxides, sulphides, and carbonates of lead are found in the reefs of most of the goldfields. The deposits are not, however, of sufficient extent to repay the cost of working. In Queensland the deposits are worked chiefly for the silver contents of the ore. Galena is found in several districts in New Zealand, but is not worked to any extent.

10. Mercury.—In New South Wales mercury was first recorded by the Rev. W. B. Clarke in 1843. Cinnabar has been found in lodes and impregnations at various places, such as Bingara, Clarence River, etc. Up to the present the production of quicksilver has been small, the total being only a little over 1000 lbs. Lodes of cinnabar have been found in Queensland at Kilkivan, and at Black Snake, in the Wide Bay district, about four tons were produced between 1874 and 1891. Small quantities have been found near Willunga in South Australia. In New Zealand cinnabar has been located at Waipori, Waitahuna, Puhipuhi, Te Aroha, and Ohaeawai. Cinnabar in the form of grains is of frequent occurrence in the alluvial deposits of the Middle Island.

11. Manganese.—Ores of this metal occur in considerable quantity in widely separated districts in New South Wales, but the low price of the metal precludes mining to any great extent, and the production to date has been trifling. In Queensland there are extensive deposits at Gladstone, the product being utilised chiefly by the Mount Morgan mine. The production from the Mount Miller mine amounted in 1907 to 1116 tons of ore, valued at £4464. Extensive deposits of the ore were mined at Boolcunda in South Australia some years ago, but latterly the production has ceased. Deposits have also been noted at Kangaroo Island, Quorn, Tumby, and various other parts of the State. In Western Australia ores of the metal are found widely scattered, the black oxide being especially plentiful in the Kimberley district. In New Zealand deposits are found in various localities, but little has been done in the way of exploration.

12. Molybdenum.—In New South Wales molybdenite is obtained at Kingsgate near Glen Innes, the export in 1907 being 22 tons, valued at £3564. The production in Queensland for the same year was valued at £3442, the bulk of which was contributed by the Hodgkinson field.

13. Tungsten.—Wolfram and scheelite, the principal ores of tungsten, are both mined to a small extent in New South Wales. During 1907 the export of wolfram was 207 tons, valued at £26,235, and of scheelite 196 tons, valued at £23,781. Wolfram was mined chiefly at Torrington, Emmaville, and Wagga, and scheelite at Hillgrove. In Queensland wolfram and molybdenum are both obtained on the Hodgkinson, Etheridge, and Herberton fields, and at Kangaroo Hills and Star River. The production in 1907 was over £90,000, chiefly contributed to by the mines on the Hodgkinson and Herberton fields. The Northern Territory of South Australia exported ore to the value of £7000 in 1906 and £11,450 in 1907. Wolfram is mined in Tasmania at Ben Lomond and in the Middlesex district, the quantity exported in 1907 being 41 tons, valued at £4411. A rich lode of scheelite has been discovered on King Island in Bass Strait. Rich deposits of scheelite have been found in New Zealand, where it is mined principally at Macrae's Flat, Otago, and Top Valley, Marlborough. The export from the scheelite mines of Otago reached £15,486 in 1907.

14. Tantalum.—Tantalite in small quantities has been found in the Greenbushes tinfield for some time past, but recently a lode of fairly extensive proportions was located at the Wodgina tinfield. Up to the end of 1905 the production of this mineral amounted to 73 tons, valued at about £10,000, but early in 1906 it was found that the supply exceeded the demand and production was temporarily stopped. Small quantities of the mineral are also produced in the Northern Territory.

In addition to the metals enumerated above there is a large number of others occurring in greater or less degree, while fresh discoveries are being constantly reported.

NON-METALLIC MINERALS (B).

§ 10. Coal.

1. **Historical.**—Coal was discovered at a very early period in the history of Australia, the first mention of it dating from August, 1797, when its existence was noted in New South Wales by some survivors from the wreck of a vessel, who had walked from the southern portion of Australia up the coast to Sydney. The discovery was shortly afterwards confirmed by Surgeon Bass, who found coal in the cliffs southward of Point Solander, but the locality was at the time looked upon as so inaccessible that no attempt was made to utilise the deposits. During 1907, however, the South Coast district, in which the site of these discoveries occurs, produced over 1,835,000 tons of coal. In 1797 coal was also discovered at the mouth of the Hunter (or Coal) River by Lieutenant Shortland, and in this case, the deposits being more easily worked, it was not long before they were utilised, and a township sprang up which is now the port of one of the greatest coalfields in the world. The production for the northern district, of which Newcastle is the port, amounted in 1907 to 6,059,000 tons, valued at £2,232,000.

The discovery of coal in *Victoria* dates from the year 1825, when the mineral is reported to have been found at Cape Patterson. There is no record of production in the earlier years, but it is stated that the first Victorian coal placed on the Melbourne market came from Kileunda, in the vicinity of the original discovery. Up to 1889, with the exception of a little work by the companies at Moe and Narracan, the industry languished, the total production to the beginning of the year named being only about 25,000 tons. Early in 1889 the Government determined to come to the assistance of the industry, and the Coal Creek Company at Korumburra was registered, followed during next year by the Jumbunna Company, and the Outtrim, Howitt, and British Consolidated in 1894. The unfortunate strike of 1903 completely disorganised coal mining in *Victoria*, and the industry still suffers from its disastrous effects. In 1908 a seam of good black coal 9 ft. 3 in. thick was reached by boring in the basin of the Powlett River. Other payable seams outcrop about five miles away, near Cape Patterson, and it is believed that the coal-bearing area extends over twelve to fifteen square miles. The Government of *Victoria* proposes to retain a considerable area in this district with a view to establish a State coal mine.

The existence of coal in *Queensland* was known soon after the establishment of the first settlement at Moreton Bay, mines near Ipswich, on the banks of the Bremer Creek and Brisbane River, having been worked almost continuously since that date. Seams in the Wide Bay district have been operated on since 1870, while good coal was mined at Clermont shortly after the establishment of the copper mines in that locality. A seam of good coal has also been discovered at Mount Mulligan, 32 miles from Dimbulah Station, on the Chillagoe railway. The industry is at present in a very satisfactory position in the northern State, and owing to the wide area over which the deposits stretch practically no limit can be set to its possibilities of extension.

In *South Australia* brown coal of fair quality was found in 1889 at Kuntha Hill, 110 miles north of Hergott, and at Lee Creek, on the Great Northern railway line. The discovery of coal in *Western Australia* dates from 1846, when the mineral was found on the Murray River. Since that year coal has been met with in other localities, but production at the present time is confined to the deposits at the Collie River. In *Tasmania* coal was discovered between the Don and Mersey Rivers in 1850. The value of the deposits at Fingal was first proved in 1863, two tons of this coal producing nearly 14,000 feet of gas. The first official record of production in *New Zealand* dates from the year 1878, when about 160,000 tons were raised.

2. **Production of Coal.**—The production of coal in each State and New Zealand at various periods since 1881, and the *value* of such production are shewn in the following table:—

PRODUCTION OF COAL, AUSTRALIA, 1881 to 1907.

State.	1881.	1891.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
QUANTITY.									
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
N.S.W. ...	1,769,597	4,037,929	5,968,426	5,942,011	6,354,846	6,019,809	6,632,138	7,626,362	8,657,924
Victoria ...	...	22,834	209,329	225,164	69,861	121,742	155,136	160,631	138,535
Q'land ...	65,612	271,603	539,472	501,531	507,801	512,015	529,326	606,772	683,272
S. Aust. ...	...	...	...	...	...	...	...	...	...
W. Aust. ...	...	...	117,836	140,884	133,427	138,550	127,364	149,755	142,373
Tasmania	11,163	43,256	45,438	48,863	49,069	61,109	51,993	52,896	58,891
C'wealth	1,846,372	4,375,622	6,880,501	6,858,453	7,115,004	6,853,225	7,495,957	8,596,416	9,681,095
N. Z'land	337,262	668,794	1,227,638	1,362,702	1,420,193	1,537,838	1,585,756	1,729,536	1,831,009
VALUE.									
	£	£	£	£	£	£	£	£	£
N.S.W. ...	603,248	1,742,796	2,178,929	2,206,598	2,319,660	1,994,952	2,003,461	2,337,227	2,922,419
Victoria ...	...	19,731	147,228	155,850	43,645	70,208	79,060	80,283	79,706
Q'land ...	29,033	128,198	189,877	172,286	164,798	166,536	155,477	173,282	222,135
S. Aust. ...	...	...	...	...	...	...	...	...	...
W. Aust. ...	...	...	68,561	86,188	69,128	67,174	55,312	57,998	55,158
Tasmania	4,465	17,303	18,175	19,546	19,628	24,444	20,797	21,158	23,556
C'wealth	636,746	1,908,028	2,602,770	2,640,468	2,616,859	2,323,314	2,314,107	2,669,948	3,302,974
N. Z'land	* 168,631	* 334,397	676,174	741,759	762,858	826,207	838,531	916,563	965,766

* Estimated.

As the table shews, the great bulk of the production is confined to New South Wales, although New Zealand has been steadily increasing its output during the last few years.

3. **Distribution and Quality of Coal in each State.**—(i) *New South Wales.* Estimates have from time to time been made as to the total quantity of coal available for working in the deposits in New South Wales, and while these naturally differ to some extent, they agree in placing the amount at well over a thousand million tons, without taking into consideration the deposits existing below a depth of 4000 feet. According to Mr. E. F. Pittman, the coal-bearing rocks of New South Wales may be classified as follows:—

COAL-BEARING ROCKS OF NEW SOUTH WALES.

Geological Age.	Maximum Thickness of Coal-bearing Strata.	Locality.	Character of Coal.
I. Tertiary—Eocene to Pliocene ...	Approx. 100 ft.	Kiandra, Gulgong, and Chouta Bay	Brown coal or lignite.
II. Mesozoic—Triassic ...	2,500 ..	Clarence and Richmond Rivers	Coal suitable for local use only.
III. Palæozoic—Permo-Carboniferous	13,000 ..	Northern, Southern and Western Coalfields	Good coal, suitable for gas, household and steaming.
IV. Palæozoic—Carboniferous ...	10,000 ..	Stroud	Very inferior.

No serious attempt has been made to use the deposits of brown coal or lignite as a source of fuel. The Triassic deposits in the Clarence and Richmond districts contain

numerous seams, but the coal is largely intersected by bands, while its large percentage of ash renders it unfit for use as fuel for industrial purposes. Probably these beds extend under the great western plains, but the presence of artesian water precludes the possibility of their being worked. It is in the Permo-Carboniferous division that the great productive coal seams of the State are found, the area which they cover being estimated at about 25,000 square miles. The coal from the various districts embraced in this division differs considerably in quality—that from the Newcastle district being especially suitable for gas-making and household purposes, while the product of the Southern (Illawarra) and Western (Lithgow) is an excellent steaming coal. The Permo-Carboniferous measures have in various places been disturbed by intrusions of volcanic rocks, which in some instances have completely cindered the seams in close proximity to the intrusive masses, while in other instances the coal has been turned into a natural coke, some of which has realised good prices as fuel.

The quantity and value of the coal raised in each district during the years 1887, 1901, and 1907 will be seen in the following table :—

COAL RAISED IN NEW SOUTH WALES, 1887 to 1907.

District.	1887.		1901.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Northern ...	Tons. 2,243,792	£ 1,096,720	Tons. 3,999,252	£ 1,669,519	Tons. 6,058,580	£ 2,231,901
Southern ...	376,568	170,684	1,544,454	407,196	1,835,425	515,786
Western ...	302,137	79,036	424,720	102,214	763,919	174,732
Total ...	2,922,497	1,346,440	5,968,426	2,178,929	8,657,924	2,922,419

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

(ii.) *Victoria.* The deposits of black coal in Victoria occur in the Jurassic system, the workable seams, of a thickness ranging from two feet three inches to six feet, being all in the Southern Gippsland district. The coal is of excellent quality for steaming and household purposes. The full exploitation of the Victorian coal deposits has, however, been rather severely hindered by various obstacles. In the Report of the Royal Commission on the Coal Industry, 1906, these have been summarised as follows:—(1) Labour troubles. (2) Difficulties of working arising from faults, displacements, and thin seams. (3) Increased cost of production as the workings extend. (4) The low price ruling for coal.

Deposits of brown coal and lignite of immense extent occur in gravels, sands, and clays of the Cainozoic period throughout Gippsland, Mornington Peninsula, Werribee Plains, Gellibrand, and Barwon and Moorabool basins. In the Latrobe Valley the beds reach a thickness of over 800 feet. When dried, the material makes good fuel, but owing to its excessive combustibility and friability requires to be consumed in specially constructed grates. Attempts have been made to manufacture briquettes from the brown coal, but so far without any great measure of success.

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

PRODUCTION OF COAL IN VICTORIA, 1902 to 1907.

Year.	Outtrim Howitt Company.	Jumbunna Coal Company.	Coal Creek Proprietary.	Silkstone Co-operative Company.	Other Companies.	Total Production.	Value.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	£
1902	114,686	67,876	39,257	2,257	1,088	225,164	155,850
1903	20,602	18,517	20,727	4,354	5,661	69,861	43,645
1904	57,828	39,364	22,547	2,014	489	121,742	70,208
1905	71,989	49,009	27,710	1,624	4,804	155,136	79,060
1906	74,812	64,222	13,214	3,977	4,406	160,631	80,283
1907	64,033	61,755	3,762	7,565	1,470	138,635	79,706

The figures for 1903 include 5661 tons of brown coal.

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

(iii.) *Queensland.* In Queensland the coal-bearing strata are of vast extent and wide distribution, being noted under the greater portion of the South-eastern districts, within 200 miles of the sea, as far north as Cooktown, and under portions of the far western interior. The Ipswich beds are estimated to occupy about 12,000 square miles of country, while the Burrum fields occupy a considerably larger area. At Callide, fifty miles west of Gladstone, a seam of coal free from bands has been struck in a shaft only sixty feet deep, and borings have proved the deposit to be of considerable magnitude. Extensive beds occur in the basin of the Fitzroy River, in the Broadsound district, and at the Bowen River. Amongst other places where the mineral is found may be enumerated Clermont, the Palmer River, Tambo, Winton, Mount Mulligan, and the Flinders River. A bituminous coal is yielded by the Ipswich seams, those of the Darling Downs yield a cannel, while anthracite of good quality is furnished by the Dawson River beds.

The quantity and value of coal raised in Queensland at various periods since 1861 were as shewn below:—

PRODUCTION OF COAL IN QUEENSLAND, 1861 to 1907.

Year	...	...	1861	1871.	1881.	1891.	1901.	1906	1907.
Quantity	Tons		14,212	17,000	65,612	271,603	539,472	606,772	683,272
Value	...	£	9,922	9,407	29,033	128,198	189,877	173,282	222,135

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

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

QUEENSLAND COLLIERIES, 1906 and 1907.

Collieries.	1906.		1907.	
	Tons Raised.	Average Value at Pit's Mouth.	Tons Raised.	Average Value at Pit's Mouth.
Ipswich and Darling Downs	509,989	s. d. 5 2½	591,174	s. d. 6 1½
Wide Bay and Maryborough	86,634	8 0½	77,921	8 4
Rockhampton and Central District	10,079	11 2½	14,077	11 6½
Other (Nundah)	70	...	100	...
Total	606,772	5 8½	683,272	6 6

A considerable proportion of the produce of the Ipswich district is supplied to vessels for bunker coal, the total in 1907 being 334,000 tons, as against 272,000 tons in 1906. Queensland coal despatched abroad amounted to 3019 tons, 3000 tons of which were shipped in one cargo to Valparaiso.

(iv.) *Western Australia.* The coal seams in Western Australia belong to the Carboniferous, Mesozoic, and Post-tertiary ages. Most of the coal contains a large proportion of moisture, and belongs partly to the hydrous bituminous and partly to the lignite class. The only coalfield at present worked is at Collie, in the Mesozoic beds of the south-west. The coal produced is bright and clean, but very fragile when free from moisture. The production from this field during the last seven years was as follows:—

PRODUCTION OF COAL IN WESTERN AUSTRALIA, 1901 to 1907.

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

(v.) *Tasmania.* In Tasmania coal occurs in the Carboniferous and Mesozoic systems, the product of the former class being, however, far inferior to that of the latter. Carboniferous seams occur at the Don, Tarleton, Latrobe, Port Cygnet, Tippagory Range, St. Mary's, and Adventure Bay, the seam at Port Cygnet having a thickness of two feet and being of fair quality. The Mesozoic coal measures are well developed in the Fingal basin, the Cornwall coal from this locality being excellent for household purposes. The chief production of recent years has been furnished by the Mt. Nicholas and Cornwall mines, but it is hoped that ere long the production from the Sandfly mine will assume considerable proportions. The quantity of coal raised during the last seven years in the various districts was as follows:—

PRODUCTION OF COAL IN TASMANIA, 1901 to 1907.

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

(vi.) *New Zealand.* New Zealand possesses coal measures of vast extent and great wealth, but as yet in a comparatively undeveloped state through lack of efficient shipping facilities on the coasts adjacent to the site of the chief deposits. The greater portion of the coal produced is of the bituminous or semi-bituminous character, but considerable quantities of brown coal and lignite are mined, and there is a small production of pitch coal. Bituminous coals are most largely mined on the west coast of the Middle Island, while the Southern district yields the chief production of brown coal, lignite, and pitch coal. Competent judges have pronounced the bituminous coals of the West Coast to be equal, if not superior, to the best description from any part of the world. Large quantities of Westport coal are supplied to the warships on the Australian Naval Station. The output of coal from the chief districts during each of the last seven years was as follows:—

PRODUCTION OF COAL IN NEW ZEALAND, 1901 to 1907.

District	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Northn.	175,084	192,045	209,795	242,517	259,876	301,186	316,977
W.Coast	669,535	753,816	781,032	836,950	856,227	962,915	1,052,022
Southn.	395,067	419,179	429,402	458,371	469,653	465,435	462,010
Total...	1,239,686	1,365,040	1,420,229	1,537,838	1,585,756	1,729,536	1,831,009

Two collieries in New Zealand, situated at Seddonville and Port Elizabeth, are owned by the State, and depôts for the sale and distribution of State coal have been established at Wellington, Christchurch, Wanganui, and Dunedin. For the year ended 31st March, 1908, the profits of the mines amounted to £8440. A briquette factory has been established in connection with the Seddonville State Colliery, and is manufacturing a product of first-rate quality, largely used on the Government railways.

4. **Production of Coal in Various Countries.**—The total known coal production of the world in 1906 amounted to about 905 million tons, towards which the Commonwealth and New Zealand contributed 10 million tons, or about 1 per cent. The following table shews the production of the British Empire and the chief foreign countries in units of 1000 tons during each year of the period 1901 to 1906:—

BRITISH EMPIRE.

Year.	United Kingdom.	British India.	Canada.	Australian C'wealth.	New Zealand.	South Africa.
	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.
1901 ...	219,047	6,636	5,791	6,884	1,228	1,465
1902 ...	227,095	7,424	6,667	6,860	1,363	2,179
1903 ...	230,334	7,438	7,107	7,112	1,420	2,911
1904 ...	232,428	8,216	7,370	6,854	1,538	3,163
1905 ...	236,129	8,418	7,739	7,496	1,586	3,603
1906 ...	251,068	9,783	8,717	8,596	1,730	3,950

FOREIGN COUNTRIES.

Year.	Russian Empire.	Sweden.	German Empire.	Belgium.	France.	Spain.	Austria-Hungary.	Japan.	United States.
	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.	1000 tons.
1901	16,215	268	106,795	21,856	31,126	2,600	12,895	8,885	261,875
1902	16,156	300	105,747	23,493	28,693	2,679	12,012	9,589	269,277
1903	17,532	315	114,763	23,415	33,668	2,654	12,526	9,979	319,068
1904	19,042	316	118,874	22,395	32,964	2,974	12,613	10,602	314,122
1905	18,389	317	119,350	21,506	34,652	3,152	13,454	11,593	350,821
1906	21,302	292	134,914	23,232	33,762	3,157	14,437	12,791	369,672

Including New Zealand the production from Australasia takes first place amongst the possessions of the British Empire.

5. **Export of Coal.**—(i.) *New South Wales.* The exports of coal from Australasia are practically confined to New South Wales and New Zealand, the quantity sent away from the latter being comparatively small. In the following table will be found the quantity and value of the exports at decennial intervals since 1881 and during the last five years, the figures for New South Wales being given on the authority of the Mines Department of that State:—

EXPORTS OF AUSTRALIAN COAL, 1881 to 1907.

Year.	Exports from New South Wales.		Exports from New Zealand.	
	Quantity.	Value.	Quantity.	Value.
	Tons.	£	Tons.	£
1881 ...	1,029,844	417,530	6,621	5,610
1891 ...	2,514,368	1,306,630	91,664	91,173
1901 ...	3,470,985	1,681,824	159,643	142,176
1902 ...	3,261,459	1,625,380	188,677	154,747
1903 ...	3,716,194	1,704,993	152,332	128,927
1904 ...	3,172,867	1,380,839	165,220	139,898
1905 ...	3,718,053	1,483,978	122,817	107,062
1906 ...	4,961,540	2,080,600	141,641	122,614
1907 ...	5,743,507	2,662,218	128,950	114,737

The principal countries to which coal was exported from New South Wales during the year 1907 were as shown hereunder:—

DESTINATION OF NEW SOUTH WALES COAL, 1907.

Country.	Quantity.	Value.	Country.	Quantity.	Value.
	Tons.	£		Tons.	£
Victoria ...	882,365	488,925	New Zealand ...	221,094	103,704
South Australia ...	599,226	342,549	Peru ...	101,131	48,681
Chile ...	878,062	446,095	Hawaii... ..	98,530	46,628
Philippine Islands...	314,235	155,430	United States ...	539,876	265,990
Straits Settlements	142,795	66,940	China	41,058	18,474

The quantity of bunker coal taken by oversea vessels was about 1,080,000 tons, valued at £531,000.

The distribution of the total output from New South Wales collieries during the last five years was as follows:—

DISTRIBUTION OF TOTAL OUTPUT OF NEW SOUTH WALES COAL.

Year.	Exports to Australasian Ports.	Exports to other Ports.	Local Consumption.	Total.
	Tons.	Tons.	Tons.	Tons.
1903	2,031,473	1,684,721	2,638,652	6,354,846
1904	1,880,545	1,292,322	2,846,942	6,019,809
1905	2,066,576	1,651,477	2,914,085	6,632,138
1906	2,260,090	2,701,450	2,664,822	7,626,362
1907	2,379,024	3,364,483	2,914,417	8,657,924

(ii.) *Queensland.* In 1907 Queensland's oversea export of coal consisted of 3019 tons, valued at £1511. of which 3000 tons, valued at £1500. were sent to Chile. In

view of the local resources, the comparatively large imports of coal and coke into the northern State are rather surprising.

(iii.) *New Zealand.* New Zealand's export consisted principally of bunker coal used on vessels trading to the United Kingdom, the amount so credited in the export returns being 76,373 tons, valued at £77,104. In addition there was an export of 22,000 tons, valued at £16,000, sent to New South Wales, the bulk of this being coal for use in British warships on the Australian station. Of the remainder the South Sea Islands took 7000 tons, valued at £4880, and Fiji 4000 tons, valued at £2700.

6. **Price of Coal.**—(i.) *New South Wales.* The price of coal in New South Wales has been subject to considerable fluctuation since the date of first production. Up to the end of 1857 the average value of the total output was 11s. 10d. per ton. Next year the value had risen to nearly 15s., declining thereafter until in 1871 the price realised was 7s. From 1872 to 1879 there was a rise in value to 12s. Between 1882 and 1891 the price ranged between 8s. and 10s. From 1891 onwards there was a steady decline until 1898, when the average was 5s. 4d. Henceforward prices rose again until 1902, when 7s. 5d. was the average. A further decline then set in until 1905, when the price stood at a little over six shillings followed by a rise of one penny in 1906. In 1907 the average was 6s. 9d. per ton. The price of New South Wales coal depends on the district from which it is obtained, the northern (Newcastle) coal always realising a much higher rate than the southern or western product. The average rate in each district during the last six years was as follows:—

PRICE OF COAL IN NEW SOUTH WALES (PER TON), 1901 to 1907.

Year.	Northern District.		Southern District.		Western District.	
	s.	d.	s.	d.	s.	d.
1901	8	4.19	5	3.28	4	9.76
1902	8	4.49	5	9.33	5	0.73
1903	8	1.04	5	8.12	5	0.14
1904	7	2.10	5	7.25	5	1.91
1905	6	4.15	5	5.03	5	0.15
1906	6	5.28	5	6.60	4	10.81
1907	7	4.41	5	7.44	4	6.90

(ii.) *Victoria.* In Victoria the average price of coal up to the 31st December, 1890, was nineteen shillings and threepence per ton. In 1895 the price was still as high as twelve shillings and twopence, but in the following five years there was a serious decline, the value in 1900 being quoted at nine shillings and sevenpence per ton. In 1901, however, there was an astonishing rise, the figure being as high as fourteen shillings and sevenpence. Since that year, however, the price again declined, the average for 1905 being ten shillings and twopence, for 1906 ten shillings, and for 1907 eleven shillings and sixpence.

(iii.) *Queensland.* The average price of coal at the pit's mouth in Queensland during the period 1900 to 1907 ranged from five shillings and eightpence halfpenny in 1906 to seven shillings in 1901. Prices in the principal coal-producing districts during the last three years were as follows:—

PRICES OF COAL, QUEENSLAND, 1905 to 1907.

District.	Value at Pit's Mouth.					
	1905.		1906.		1907.	
	Per ton.	Per ton.	Per ton.	Per ton.	Per ton.	Per ton.
Ipswich and Darling Downs	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Wide Bay and Maryborough	5 4	5 2½	8 0¾	6 1½	8 4	11 6½
Rockhampton and Central	7 8½	11 2½	12 0	8 4	11 6½	11 6½

(iv.) *Western Australia.* The average price of the Collie (Western Australia) coal up to the end of 1901 was nine shillings and fourpence per ton, the price in 1901 being eleven shillings and sevenpence. In 1902 the average stood at twelve shillings and threepence, but since that time there has been a steady fall, the lowest point being reached in 1906, when the price was 7s. 7½d. per ton. In 1907 the average was 7s. 8½d.

(v.) *Tasmania.* The average price per ton of coal at the pit's mouth in Tasmania was eight shillings in 1901. In 1902 it was eight shillings and sevenpence, in 1903 eight shillings and ninepence, in 1904 nine shillings and eightpence, in 1905 nine shillings and eightpence, in 1906 nine shillings and ninepence, and in 1907 eight shillings per ton.

7. **Price of Coal in other Countries.**—According to a report published by the Board of Trade the average value of coal at the pit's mouth in the five principal coal-producing countries of the world, for the three years ended 1906, was as follows:—

PRICES OF FOREIGN COAL.

Year.	United Kingdom.	Germany.	France.	Belgium.	United States.
	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.	Per ton. s. d.
1904 ...	7 2½	8 6½	10 10½	10 8	5 10¾
1905 ...	6 11½	8 7½	10 6¾	10 2½	5 8
1906 ...	7 3½	8 11½	...	...	5 9½

The price of coal at the pit's mouth in the principal British possessions is averaged by the same authority as follows:—

PRICE OF COAL, BRITISH POSSESSIONS.

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

A consideration of the above and preceding figures will shew that throughout the world the price of coal has, generally speaking, undergone a considerable decline during the last few years, although the latest returns shew an upward tendency.

8. **Employment in Coal Mining.**—The number of persons employed in coal mining in each of the States and New Zealand during the year 1907 is shewn below. The table also shews the number of persons killed and injured, with the proportion per 1000 employed, while further columns are added shewing the quantity of coal raised for each person killed and injured, this being a factor which must be reckoned with in any consideration of the degree of risk attending mining operations.

Returns published by the Board of Trade, England, give the total known number of persons engaged in mining and quarrying throughout the world as about 5½ millions, more than one-half of whom were employed in coal mining, the number in Great Britain being 867,000; the United States, 641,000; Germany, 569,000; France, 178,000; Belgium, 139,000; Austria, 121,000; and India, 99,000.

The latest returns shew the death rate in the United Kingdom as 1.29, and for the British Empire 1.34 per 1000 persons employed in coal mines. For France the rate is given as 7.17, for Germany 1.88, and the United States 3.21. For foreign countries generally the rate is stated at 2.99 per 1000. The high rate in France was due to an unusual casualty list in 1906, the rate for the preceding year being 1.04.

EMPLOYMENT AND ACCIDENTS IN COAL MINING, 1907.

State.	Persons Employed in Coal Mining.	No. of Persons.		Proportion per 1000 Employed.		Tons of Coal Raised for Each Person.	
		Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
New South Wales ...	17,080	17	99	1.0	8.9	509,290	56,588
Victoria ...	599	1	3	...	5.0	138,585	46,195
Queensland ...	1,505	...	24	...	15.9	...	28,470
South Australia ...	...	...	...	...	...	...	...
Western Australia ...	253	1	13	3.9	51.3	142,373	10,944
Tasmania ...	198	...	4	...	20.0	...	14,723
Commonwealth ...	19,635	19	143	1.0	7.28	509,529	49,142
New Zealand ...	3,910	12	33	3.1	8.4	152,584	55,485

THE AVERAGE FOR THE LAST SIX YEARS AVAILABLE IS GIVEN BELOW:—

New South Wales ...	14,500	32.0	94.7	2.2	6.5	215,000	73,000
Victoria ...	700	1.2	9.2	1.7	13.1	120,000	16,000
Queensland ...	1,400	0.5	18.3	0.4	13.1	1,113,000	30,000
South Australia ...	...	...	...	...	...	...	...
Western Australia*	340	0.3	11.2	0.9	33.0	462,000	12,000
Tasmania ...	200	...	1.5	...	...	...	36,000
Commonwealth ...	17,140	34.0	134.9	2.0	7.9	228,000	57,000
New Zealand ...	3,300	5.7	19.7	1.7	6.0	277,000	80,000

* Two killed; one in 1903, one in 1907.

§ 11. Coke.

1. **Production of Coke.**—Notwithstanding the large deposits of excellent coal in Australia there is at the present time a fairly considerable amount of coke imported from abroad, the oversea import during the year ended 1907 amounting to 9800 tons, valued at £13,250, the bulk of which came from the United Kingdom and Germany, and was taken chiefly by South Australia and Western Australia. Various reasons were at one time adduced to account for the rejection of the local article, such as excessive friability in transport, lack of strength to sustain the weight of large ore bodies in reduction works, excessive amount of ash, etc. These disabilities have, however, largely been overcome, so that succeeding years should see continued expansion in local production. Extensive shipments of coke were obtained from Germany in 1908 for the Wallaroo and Moonta smelters, and for the Broken Hill Proprietary's works at Port Pirie. In explanation of this, it has been stated that while supplies in Australia were not sufficient to meet demands and ensure continuity in supply, there has been considerable over-production at German coke works. In New South Wales the industry is making rapid progress, as the figures hereunder will shew:—

COKE MADE IN NEW SOUTH WALES.

Year.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Quantity Tons	128,882	126,872	160,592	171,006	162,961	186,060	254,609
Value ... £	105,665	89,605	108,764	110,692	100,306	110,607	159,316

A small quantity of coke is made in Queensland, but the bulk of that used in ore reduction is imported, mainly from New South Wales. The coke manufactured locally amounted in 1905 to 8650, in 1906 to 8672, and in 1907 to 8280 tons, while the imports for the same years came to 9823, 22,661, and 34,013 tons respectively.

New Zealand formerly produced a fair amount of coke, the records for 1892 shewing an export of local produce amounting to over 4000 tons, valued at £5700. The production has, however, dwindled away, and from 1900 to 1907 there was a continuous rise in imports, ranging from 963 tons, valued at £2451, to 4391 tons, valued at £8854.

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

§ 12. Oil Shale and Mineral Oils.

1. **Production of Shale.**—(i.) *New South Wales.* As pointed out by Mr. E. F. Pittman, the name kerosene shale has been rather inaptly applied to a variety of torbanite, cannel, or boghead mineral found at various geological horizons in New South Wales. The mineral does not, as a rule, split in parallel layers, the fracture being rather of a conchoidal type. Pure samples have been found to contain over 89 per cent. of volatile hydro-carbons and over 5 per cent. of fixed carbons. The discovery of the mineral in New South Wales dates probably from 1827, although the first authentic mention by a scientific observer dates from 1845, when its occurrence in the Hartley Vale district was noted by Count Strzelecki. The mineral has been found at several places in the Upper Coal Measures, and in at least two in the Lower Carboniferous. Production on anything like a large scale commenced in 1868, when about 17,000 tons, valued at £48,000, were raised. The production in 1907 amounted to 47,000 tons, valued at £32,055, the whole of it being raised in the mines controlled by the Commonwealth Oil Corporation Limited at Hartley Vale, New Hartley, and Wolgan. Up to the end of 1907 the entire production for the State amounted to 1,327,000 tons, valued at £2,167,500.

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

(iii.) *Queensland.* Deposits of oil shale are known to exist at various localities in Queensland, and what is believed to be a payable oil bearing area has been located by a bore near Roma. At the time of compilation of this article, however, developmental work had not sufficiently progressed to enable a definite statement to be made.

(iv.) *South Australia.* In this State large areas of bituminous shale, of which the boundaries are only approximately known, occur at Leigh's Creek and Lake Phillipson. Allusion to the mineral known as Coorongite is made in Section 13.

(v.) *Western Australia.* A deposit of carbonaceous shale of considerable thickness is known to exist at Coolgardie, but the mineral has not yet been raised in any quantity.

(vi.) *Tasmania.* The deposits of oil shale (Tasmanite) in the Mersey district are not at present being worked, but operations are in progress with a view to testing their value. Kerosene shale of fine quality is found in the country between the Jessie and Flowerdale Rivers, but the extent of the beds has not been proved.

(vii.) *New Zealand.* Mineral oil has been known to exist for some years in New Zealand in the locality of New Plymouth, and also near Gisborne and the East Cape, while small quantities are at times noticeable on hot pools in the volcanic district. Up to the end of 1907 no developments of commercial value had resulted from oil-boring operations in Taranaki and at Kotuku, near Lake Brunner.

2. **Export of Shale.**—In 1907, New South Wales exported 5686 tons of shale valued at £13,546, of which 5080 tons, valued at £11,957, were sent to the Netherlands.

§ 13. Other Non-Metallic Minerals.

1. **Alunite.**—Probably the most remarkable deposit of alunite in the world occurs at Bulladelah, in the county of Gloucester, New South Wales, a large proportion of a low range of mountains in the district being composed of this mineral. The deposits are worked by quarrying, and up to the end of 1907 about 29,000 tons had been raised, valued at £87,700, the production for the year 1907 being 2087 tons, valued at £5115.

2. **Asbestos.**—This substance has been found in various parts of Australia, but up to the present has not been produced in sufficient quantity to warrant special notice. In Western Australia what may prove to be a valuable deposit of the fibrous chrysotile variety has been located at Tambourah, on the West Pilbara goldfield. In 1899 Tasmania raised 200 tons, valued at £363, but there has been no production during the last seven years.

3. **Clays.**—Valuable deposits of clays of various sorts are found throughout the Commonwealth. There is a considerable local production of earthenware, bricks, and tiles, but the finer clays have not as yet been extensively used. On Kangaroo Island, South Australia, where, it is stated, the first pottery mill in the Commonwealth was erected, there are vast deposits of felspar, china stone, silica, and firebrick clay.

4. **Coorongite.**—This peculiar indiarubber-like material was first noted many years ago near Salt Creek and in the vicinity of Coorong Inlet, in South Australia. It was thought that the substance owed its origin to subterranean oil-bearing strata, but so far the search for petroleum has not been attended with success.

5. **Graphite.**—Graphite is found in New South Wales near Undercliff Station, in the county of Buller, but the deposit is not sufficiently pure to prove remunerative. In Victoria the mineral occurs in Ordovician slates in several of the goldfields, but is not worked. In Queensland the mineral is raised by the Graphite Plumbago Company at Mt. Bopple, near Netherby, on the Maryborough-Gympie line. The quantity produced in 1907 was sixty-five tons, valued at £200. There is an extensive deposit of the mineral at Mt. Bopple, but the quality is rather inferior.

6. **Gypsum.**—This mineral is found at various places in the Commonwealth. In South Australia deposits are being worked at Lake Fowler and near Marion Bay, Yorke Peninsula. At Boort, in Victoria, 1036 tons, valued at £259, were raised in 1907.

7. **Tripolite, or Diatomaceous Earth.**—Although tripolite has been found at Barraba, Cooma, Wyrallah, and in the Warrumbungle Mountains in New South Wales, the deposits have not yet been worked commercially. In Victoria there is a remarkably pure deposit at Lillieur, near Talbot, while beds of the mineral are also met with at Clunes and Portland. From the deposit at Talbot, 155 tons valued at £930 were obtained in 1907.

8. **Salt.**—Salt is obtained from salt lakes in the western and north-western districts of Victoria, and from salterns in the neighbourhood of Geelong. In Western Australia supplies are obtained from dried-up shallow lakes and consumed locally or exported. The chief centres of production are Rottnest Island, near Fremantle, and Middle Island, near Esperance, the product from the former being a remarkably pure chloride. Large quantities are also obtained from the shallow salt lakes of South Australia, chiefly on Yorke Peninsula. Lake Hart, about sixty square miles in area, situated about 120 miles N.W. from Port Augusta, contains immense supplies of salt of good quality which at present, however, owing to distance from market possess no economic value. The salt is simply scraped from the beds of the lakes in summer time and carted to the refinery. It is stated that care must be taken not to leave too thin a crust of salt over the under-

lying mud, as the resultant "crop" after the winter rains will in that case be smaller than usual. The production of crude salt in South Australia during 1906 was 55,000 tons, valued at £27,500.

9. **Natural Manures.**—In Victoria large quantities of "copi," an impure hydrous sulphate of lime, are obtained in the North-western district. South Australia possesses deposits of rock phosphate near Port Clinton and Ardrossan on Yorke Peninsula, at Belvedere near Kapunda, and at Kooringa. The production in 1907 was 8000 tons. Although it can hardly be considered a mineral product, mention may be made here of the large accumulations of guano on the Arolhos Islands, off the coast of Western Australia, in the neighbourhood of Geraldton. The deposits vary in thickness from four to twenty-seven inches. During the years 1876-80 over 36,000 tons were raised, no figures being available shewing the production of recent years.

In New Zealand, fairly extensive deposits of phosphates have been located at Clarendon in the Otago district, but the production has not up to the present reached any magnitude.

§ 14. Gems and Gemstones.

1. **Diamonds.**—Diamonds were first noted in New South Wales by E. J. Hargraves in 1851, and in October of the same year by Geological Surveyor Stutchbury. The Cudgong field was discovered in 1867, and shortly afterwards the Bingara diamantiferous deposits were located. None of the diamonds so far discovered have proved of any considerable size, the largest weighing about $6\frac{1}{2}$ carats. Stones of small size are also found at Cope's Creek and other places in the Inverell district. The chief production in 1907 was from Copeton in the Tingha Division. It is difficult to obtain accurate returns in connection with the production of precious stones, but the yield of diamonds in 1907 was estimated at 2539 carats, valued at £2056, while the total production to the end of 1907 is given as 159,675 carats, valued at £106,145. Small quantities of diamonds are found in Victoria in the gravels of streams running through granite country in the Beechworth district; at Kongbool in the Western District; and near Benalla. The stones are generally small, and the production up to date has been trifling. A few small diamonds have been found in the Pilbara district in Western Australia. In South Australia diamonds have been found on the Echunga goldfield, the most notable gem being Glover's diamond, which was sold for £70.

2. **Sapphires.**—These gems were discovered in New South Wales in 1851, near Burrandong. The gems have also been found in small quantities near Inverell, and at a few other localities in the State. There is no record of production. Specimens of sapphire have been found in Victoria, but the stones of commercial size are generally of little value owing to flaws.

In Queensland sapphires are found in the gravel of creek beds, between Withersfield and Anakie on the Rockhampton-Winton railway line. The gems show excellent fire and lustre, but the colour is darker blue than the Oriental sapphire. Hyacinths are occasionally found in association with the gems. The production of all gems in Queensland last year was valued at £40,500, and up to the end of 1907 the total was £103,000.

3. **Precious Opal.**—This stone was first discovered in New South Wales at Rocky Bridge Creek on the Abercrombie River, in the year 1877, and later a most important discovery was made at White Cliffs in the Wilcannia district, which is now the centre of production. The total value of opal raised last year was estimated at £79,000, of which £66,000 worth was raised in the White Cliffs district, and the balance at the Wallangulla field in the Walgett division. Beautiful specimens of "black" opal, realising over £40 an ounce, have been obtained at the last-mentioned field. Since the year 1890 the total value of opal won is estimated at £1,068,000.

Small quantities of precious opal are also found in the Beechworth district in Victoria. In Queensland, the first recorded discovery of the gem dates from about 1875.

The opaliferous district stretches over a considerable area of the western interior of the State, from Kynuna and Opalton as far down as Cunnamulla. The yield in 1907 was estimated at £3000, and up to the end of that year at £159,000. These figures are, however, merely approximations, as large quantities of opal are disposed of privately to buyers on the fields, no record of which is obtained.

4. **Other Gems.**—Emeralds were found in New South Wales in the year 1890, near the township of Emmaville, the largest specimen found in the district weighing twenty-three carats in the rough. Altogether 2225 carats were sent to London during that year, some of the gems bringing £4 a carat, but the production has since dwindled, there being no record of any yield in 1906. Amongst other gems found in New South Wales at various times may be mentioned *turquoises*, discovered in 1894, near Bodalla, *topazes*, fine specimens of which have been obtained in the New England district, and *zircons* and *garnets*. Turquoises are also found in thin veins in Victoria, but the deposit is not rich enough to pay for expenses of working. Fine *agates* are found in many places in Victoria, but have not been made use of to any extent. Garnets are found in Western Australia, and beautiful specimens of *crocidolite* have been obtained at Yarra Creek in the Murchison district. *Rubies* have been found at various places in New South Wales and Queensland, and in the Westland district of Middle Island, New Zealand. In South Australia *tourmaline* has been found on Kangaroo Island and *beryls* near Williamstown.

§ 15. The Mineral Wealth of Australasia.

1. **Total Production.**—(i.) *Australia.* The value of the production from all minerals raised in Australia during 1907 is given in the following table:—

MINERAL PRODUCTION IN 1907.

Minerals.	N.S.W.	Victoria.	Q'land.	S.A.	W.A.	Tas.	Cwth.
	£	£	£	£	£	£	£
Alunite	5,115	...	...	...	...	...	5,115
Antimony	46,278	13,290	7,863	...	630	...	68,061
Bismuth	5,268	...	1,806	...	...	27	7,101
Chrome	105	...	...	...	...	...	105
Coal	2,922,419	79,706	222,135	...	55,158	23,556	3,392,974
Coke	159,316	...	...	...	...	...	159,316
Copper	727,774	2,356	1,028,179	705,031	180,387	869,666	3,513,393
Diamonds	2,056	...	...	...	...	...	2,056
Diatomaceous earth	50	930	...	...	...	...	980
Gems (unspecified)	...	...	40,500	...	...	...	40,500
Gold	1,050,730	2,954,617	1,978,938	42,468	7,210,749	277,607	13,515,109
Graphite ... ..	...	...	200	...	...	...	200
Gypsum ... ..	...	259	...	...	...	...	259
Iron	60,550	...	...	...	...	...	60,550
Iron oxide	1,961	...	...	...	...	1,150	3,111
Ironstone flux ...	7,707	...	24,327	38,100	438	...	70,572
Kaolin	740	772	...	...	...	...	1,512
Lead	374,182	...	75,330	...	1,292	...	460,804
Limestone flux ...	16,162	...	35,808	5,800	1,382	...	59,152
Manganese ... ..	...	...	4,464	...	...	...	4,464
Molybdenite	3,564	...	8,442	...	...	...	12,006
Opal	79,000	...	3,000	...	...	...	82,000
Platinum	1,014	...	...	...	...	...	1,014
Salt ... ..	...	19,996	...	37,500	...	...	57,496
Scheelite	23,781	...	320	...	...	...	24,101
Shale	32,055	...	...	...	...	...	32,055
Silver	257,314	4,355	112,540	780	25,382	...	400,371
Silver-lead bullion	3,658,632	...	...	...	...	572,560	4,244,285
Silver-lead ore ...	...	10,531	496,766	13,093	158,648	501,631	1,502,296
Tin	293,305	...	496,766	41,365	...	4,411	133,082
Wolfram	26,235	...	90,985	11,451	...	...	536,620
Zinc	536,620	...	...	10,500	...	...	10,668
Uncenumerated ...	186	...	...	...	...	...	...
Total	10,292,119	3,086,812	4,131,603	906,088	7,634,066	2,250,658	28,301,346

In the next table will be found the estimated value of the total mineral production in each State up to the end of 1907. The figures do not in all cases coincide with those published by the Mines Departments, as they are exclusive of certain items such as building stones, clay, cement, and lime, which appear in some of the mining returns. The New South Wales Mining report gives the production of building stone up to the end of 1907 as £17,801 (this figure, however, representing exports alone), while the production in Victoria during the period 1866-1906 is given in the Victorian Mines Report as £3,413,937. For comparative purposes the figures are therefore valueless, the utility of export figures for such a commodity as building stone being more or less dubious.

COMMONWEALTH MINERAL PRODUCTION TO END OF 1907.

Minerals.	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tas.	C'wealth.
	£	£	£	£	£	£	£
Gold ...	55,364,882	279,471,596	66,313,841	2,749,609	78,004,408	6,523,821	488,428,157
Silver and lead	47,526,887	212,139	1,540,186	401,777	572,470	4,827,825	55,081,285
Copper...	9,200,403	125,810	5,430,182	26,280,877	658,516	7,623,227	49,319,015
Tin ...	8,037,814	452,061	6,607,965	179,267	755,821	9,676,861	25,709,789
Coal ...	53,279,161	1,556,981	3,876,503	...	542,066	422,681	59,677,392
Other ...	7,669,625	292,432	1,091,543	1,040,001	56,310	126,402	10,276,313
Total ...	181,078,772	282,111,019	84,860,220	30,651,531	80,589,591	29,200,818	688,491,951

The "other" minerals in New South Wales include antimony, £299,557; bismuth, £119,882; chrome, £101,108; diamonds, £106,145; opal, £1,068,099; oil shale, £2,167,500; and zinc, £1,426,894. In the Victorian returns antimony ore was responsible for £194,101, and salt £54,206. Included in "other" in the Queensland production were opal, £158,695; gems, other, £102,277; bismuth, £79,695; wolfram, £447,523; antimony ore, £50,412; and manganese, £48,632. The chief item in South Australian "other" minerals was salt, £644,500. In the Tasmanian returns limestone flux was responsible for nearly £100,000.

(ii.) *New Zealand.* The production of minerals in New Zealand during 1907 and up to the end of that year is given below:—

MINERAL PRODUCTION OF NEW ZEALAND, 1907, and Total to 1907.

Minerals.	During 1907.	To end of 1907.	Minerals.	During 1907.	To end of 1907.
	£	£		£	£
Gold ...	2,027,490	71,528,978	Coal ...	965,766	13,492,470
Silver ...	169,484	1,090,751	Kauri Gum ...	579,888	14,022,905
Copper ...	595	18,823	Other ...	30,468	214,584
Chrome ...	...	38,002			
Antimony ...	2,118	54,716	Total ...	3,775,835	100,523,086
Manganese ...	26	61,857			

The so-called kauri gum—which is really a resin—has contributed about 14 per cent. of the total mineral production of New Zealand. The substance is the solidified turpentine of the kauri pine, and is used as the base of the best oil varnishes. It is obtained chiefly in the Auckland provincial district of the North Island, being found alike in the driest fern banks and the deepest swamps. A certain amount is also got from the forks of standing trees.

2. **Total Employment in Mining.**—The number of persons engaged in the mining industry in each State and New Zealand is an index of the significance of the mineral wealth. During the year 1907 this was as follows:—

EMPLOYMENT IN MINING, 1907.

State.	Number of Persons Engaged in Mining for						Total.
	Gold.	Silver, Lead, and Zinc.	Copper.	Tin.	Coal and Shale.	Other.	
New South Wales ...	7,468	10,021	3,764	3,173	17,356	1,976	43,758
Victoria ...	23,291	10	10	87	599	128	24,125
Queensland ...	8,883	785	3,941	2,582	1,573	1,434	19,198
South Australia ...	914	86	5,254	554	...	1,033	7,841
Western Australia ...	17,237	8	611	1,003	253	1	19,113
Tasmania ...	953	1,908	2,614	1,828	198	15	7,516
Commonwealth ...	58,746	12,818	16,194	9,227	19,979	4,587	121,551
New Zealand ...	9,138	...	112	2	3,692	137	13,081

The following table shews the number of persons engaged in mining in the Commonwealth and New Zealand during each of the years 1891, 1901, and 1907, together with the proportion of the total population so engaged:—

PROPORTION OF PERSONS ENGAGED IN MINING, AUSTRALASIA,

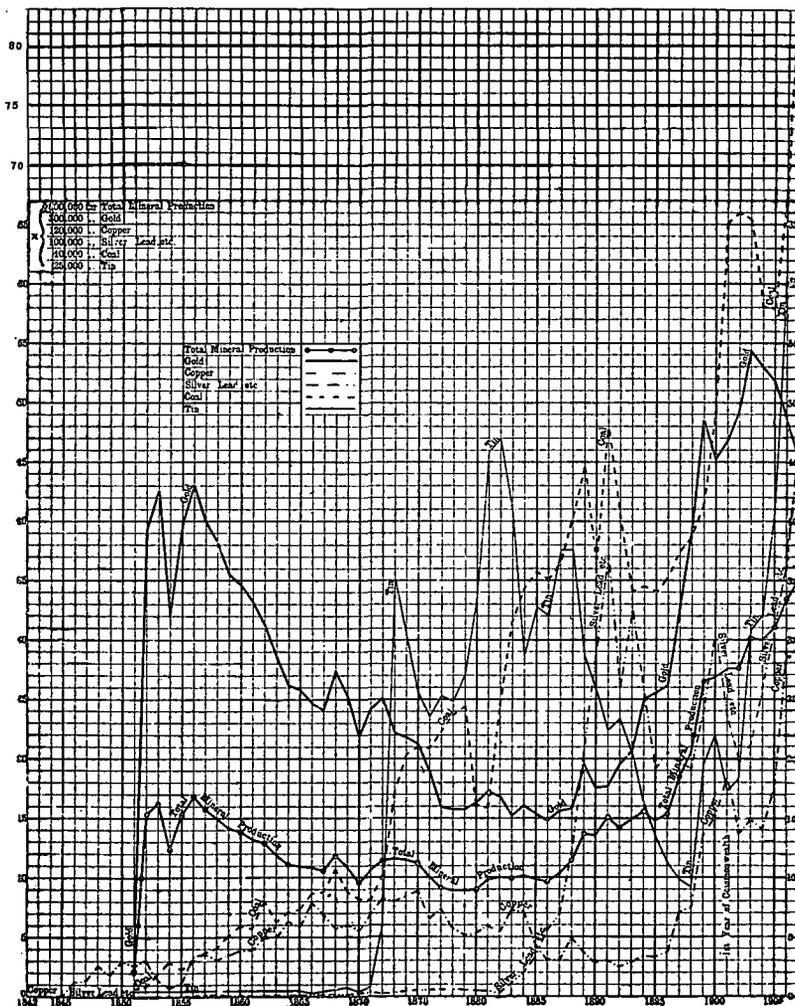
1891, 1901, 1907.

State.	1891.		1901.		1907.	
	Miners Employed.	No. per 100,000 of Popu- lation.	Miners Employed.	No. per 100,000 of Popu- lation.	Miners Employed.	No. per 100,000 of Popu- lation.
New South Wales ...	30,604	2,700	36,615	2,685	43,758	2,822
Victoria ...	24,649	2,151	28,670	2,381	24,125	1,947
Queensland ...	11,627	2,934	13,352	2,664	19,198	3,562
South Australia ...	2,683	834	7,007	1,931	7,841	2,033
Western Australia ...	1,269	2,496	20,895	11,087	19,113	7,286
Tasmania ...	3,988	2,695	6,923	4,017	7,516	4,190
Commonwealth ...	74,820	2,341	113,462	2,992	121,551	2,925
New Zealand ...	16,929	2,688	12,732	1,637	13,081	1,423

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

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

GRAPHS SHEWING VALUES OF PRINCIPAL MINERALS PRODUCED IN THE COMMONWEALTH, 1842 to 1907.



EXPLANATION OF GRAPHS—The values shown in the above diagrams are those of the total Commonwealth production of the most important minerals in successive years from 1842 to 1907.

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

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

WAGES PAID IN MINING INDUSTRY IN THE COMMONWEALTH.

Class of Mine.	New South Wales.	Victoria.	Queensland.	South Australia.	Western Australia.	Tasmania.
GOLD—						
Labourers	per day. 7/- to 8/2	per week. £1 13/- to £2 2/-	per day. 6/9 to 11/2	per day. 6/8	per day. 10/- to 11/10	per day. 6/- to 7/-
Bracemen	7/- to 8/-	£2 to £2 5/-	7/1 to 11/1	8/-	11/8 to 13/6	7/- to 8/8
Platmen	7/- to 8/-	£1 19/- to £2 2/-	7/9 to 9/6	7/-	11/8 to 13/6	7/6
Miners	8/4 to 9/3	£2 5/- to £2 10/-	8/2 to 12/-	8/9		7/6 to 8/-
Wet	10/2	£2.10/-	...	11/-	} 11/8 to 16/3 {	8/4 to 9/2
Shaft-sinking	9/- to 10/6	{ £2 8/- for 6 hr. shifts }	...	10/-		8/4
Wet	10/- to 12/-	£2 8/-	9/9 to 12/9	8/9	13/4 to 15/4	8/4 to 9/-
Blacksmiths	10/- to 11/-	£2 8/-	9/1 to 12/10	9/3	15/-	8/- to 8/4
Carpenters						
Engine-drivers—						
Stationary	} 8/- to 10/- {	£2 10/-	} 9/10 to 13/3 {	8/3	} 13/4 to 15/- {	8/- to 8/4
Winding		£2 10/-		9/-		8/4 to 9/6
Battery feeders	...	...	6/6 to 11/4	6/8	10/- to 11/10	5/- to 8/-
Shift bosses	10/- to 12/-	£2 10/-	10/7 to 13/10	12/-	16/8	9/2 to 10/-
Machine miners	9/- to 10/6	£2 5/-	8/4 to 11/9	10/-	13/4 to 15/6	8 4
Timbermen	9/- to 9/2	£2 5/-	9/2 to 11/8	9/3	13/4 to 15/-	8/4
			(Note.—The above figures refer to averages per shift in all metalliferous mines in Q'nsland)			
SILVER-LEAD*						
Labourers	7/6	} Not mined. {	...	6/8	} Same as gold. {	7/6 to 8/6
Bracemen	8/4		...	8/-		7/9 to 9/-
Miners	9/-		...	8/9		8/4 to 10/-
Blacksmiths	9/- to 10/6		...	8/9		8/4 to 12/2
Carpenters	9/- to 10/6		...	9/3		9/6 to 13/4
Engine-drivers			...			
Winding	10/-		...	9/-		9/4 to 10/-
Shift bosses	14/-		...	12/-		10/- to 12/- & at salary of £4 pr. wk.
Truckers	7/6		...	7/6		7/6 to 8/6
Timbermen	10/-		...	9/3		8/4 to 10/-
COPPER—		per shift.				\$
Labourers	7/6 to 8/4	6/-	...	6/8		8/- to 10/6
Miners	8/4 to 10/2	7/6	...	8/9		9/6 to 10/6
Blacksmiths	10/- to 13/4	8/4	...	8/9		10/6 to 13/-
Carpenters	...	8/4	...	9/3		10/6 to 12/6
Engine-drivers—						
Winding	...	8/4	(see above)	9/-	Do.	11/-
Bracemen	8/- to 9/3	6/6	...	8/-		9/- to 9/6
Drill sharpeners	9/- to 13/-	7/6	...	9/-		9/- to 9/6
Timbermen	9/2 to 10/8	7/6	...	9/3		10/- to 12/6
Machine miners	9/2 to 10/6	...	...	9/8		9/6 to 10/6
Miners in wet ground	9/4 to 11/-	...	...	11/-		...
TIN—		per day.				
Labourers	7/6 to 8/-	6/- to 7/-	...	6/8		7/- to 8/-
Miners	...	7/6	...	8/9		8/- to 8/6
Blacksmiths	...	8/4 to 10/-	...	8/9		9/- to 12/-
Carpenters	...	8/4 to 10/-	...	9/3		9/- to 10/6
Engine-drivers—						
Stationary	...	8/4	(see above)	8/3	Do.	9/6 to 11/-
Shift bosses	...	8/- to 10/-	...	12/-		8/6 to 10/-
Nozzlemen	} Boxmen 8/4 {	7/- to 8/-	...	10/-		7/6 to 8/6
Racemen		} Sluicemen 7/- {	9/-		7/- to 9/6
Face bosses	7/6		
COAL—		per shift.			†	
Deputies	10/- to 11/-	9/- to 12/-	...	...	13/4	8/-
Shot firers	9/-	...	...	...	13/2	...
Shiftmen	6/- to 12/4	...	...	...	13/2	7/6
Wheelers	5/- to 9/1	5/6 to 7/-	...	...	11/2 to 12/4	5/- to 6/-
Overmen	£3 to £5 week	...	...	...	On salary.	10/- to 11/-
Miners	10/- to 15/-	7/6 to 9/-	...	...	13/2	8/- to 10/-
Machinemmen	11/- to 14/-	...	...	...	12/10 to 14/8	...
Enginemmen—						
Winding	10/- to 11/-	8/4	...	Not mined.	12/4	8/4
Hauling	8/- to 9/-	...	...	...	...	10/-
Other	8/- to 10/-	...	...	...	...	8/4
Labourers	6/- to 7/-	6/-	...	...	9/4	6/- to 7/6
Blacksmiths	8/- to 10/-	8/4	...	...	12/2	7/6
Carpenters	9/- to 10/-	8/-	...	...	11/4	6/6 to 7/6
Safety lampmen	8/- to 10/-	6/- to 6/6	...	...	...	...
Platmen or banksmen	8/- to 9/-	5/6 to 7/6	...	...	...	...

* To these rates the following bonus applies for two years from 1st January, 1907. From 7/6 to 8/4, 15 per cent.; over 8/4 to 9/-, 14 per cent.; over 9/-, 1/- per shift. † Also turners, 13/2; fillers, 11/4; set riders, 13/4; firemen, 11/4. § Also navvies, 8/6; winchmen, 10/6; platmen, 9/- to 9/6; punnpnen, 12/-; truckers, 8/- to 8/6; shift bosses, 12/- to 13/4; firemen, 8/6; brakemen, 9/6; fitters, 10/- to 13/4; plumbers, 10/6; electricians, 9/- to 10/6; gangers, 12/6; powder monkeys, 8/6 to 10/-; boys, 4/6 to 6/6.