

CHAPTER 26

MINERAL INDUSTRY

Further detailed statistics and information on the subjects dealt with in this chapter are contained in the annual printed bulletin *The Australian Mineral Industry—Annual Review* and other publications issued by the Bureau of Mineral Resources, Geology and Geophysics, which also issues, in conjunction with this Bureau, a quarterly publication, *The Australian Mineral Industry, (Quarterly Review and Statistics)* (10.17). The annual statistical bulletins *Mining Establishments, Summary of Operations (Preliminary)* (10.72), *Mining Establishments, Details of Operations* (10.60), *Mineral Production* (10.51), *Mineral Exploration* (10.41), *Mineral Exploration (other than for Petroleum) (Preliminary)* (10.71) and *Mining Industry, Foreign Ownership and Control* (10.42) of this Bureau contain economic statistics of the industry prepared and published as soon as possible after the data have been compiled. A monthly statistical bulletin *Minerals and Mineral Products* (10.19) is issued also, and other current statistics on mining or mine products are contained in the *Quarterly Summary of Australian Statistics* (1.3), the *Monthly Review of Business Statistics* (1.4), the *Digest of Current Economic Statistics* (1.5), and the *Monthly Bulletin of Production Statistics* (12.14).

GENERAL

Geology

General geology

Most of the western and central part of the Australian continent consists of basement rocks of Precambrian age. Younger Palaeozoic rocks, mostly of geosynclinal origin, form a discontinuous belt several hundred miles wide extending from north Queensland to Tasmania. Mesozoic platform sediments form a broad zone separating the Palaeozoic and Precambrian rocks and extending from the Gulf of Carpentaria to central New South Wales. Cainozoic rocks occur mainly in Victoria, south-western New South Wales and southern South Australia, and as residual basalt cappings over extensive areas of the Palaeozoic rocks of eastern Australia.

Economic geology

Minerals of economic significance occur widely throughout the Precambrian and Palaeozoic rocks of the continent. Palaeozoic mineralisation is perhaps more varied, but the Palaeozoic deposits now being worked are in general smaller than those found in Precambrian rocks. Most of Australia's metallic mineral deposits occur within two broad regions, a region of Precambrian rocks in the west and central areas of the continent and a region of younger Palaeozoic rocks in the east.

The major deposits of metallic ore minerals, including those of iron, lead, zinc, silver, copper, uranium, nickel, and gold, are contained in the Precambrian rocks of the Australian shield. Smaller deposits of ores of tin, tungsten, tantalum, beryllium, manganese, cobalt, and mica are also contained in these rocks.

The mineralised Palaeozoic rocks contain major deposits of gold, now mostly worked out, and a few large copper and lead-zinc-silver ore occurrences. Smaller amounts of ores of tin, tungsten, molybdenum, bismuth, antimony, and ores of other metals also occur in these rocks.

Outside these two main categories, however, there are some metallic mineral deposits of considerable economic importance which were formed during the Tertiary Period. These include bauxite (the ore of aluminium) which occurs as a surface capping over rocks of various ages, the result of a long period of weathering and reworking. Extensive deposits of bauxite occur at Weipa on Cape York Peninsula in north Queensland, at Gove on the north-eastern tip of the Northern Territory, in the Darling Range in Western Australia and near Kalumburu in the north-west of Western Australia.

Other important deposits which are the results of weathering are the lateritic nickel deposits at Greenvale and Rockhampton in Queensland, and in the Kalgoorlie and Wingellina areas of Western Australia. Mineral sands, another important exception, contain rutile and ilmenite (ores of titanium), zircon (zirconium ore), monazite (thorium ore), and other minerals, and are particularly well developed on the coasts of central and northern New South Wales, southern Queensland and south-western Western Australia. The immediate source of the deposits of the eastern States is considered to be Mesozoic sedimentary rocks. The Western Australian deposits are thought to be derivatives of the Precambrian granites of the Australian shield.

Occurrences of fuel minerals (coal, oil and natural gas) are characteristically located in sedimentary basins. Large areas of Australia are covered by these basins, and more than twenty major sedimentary basins have been identified on the Australian mainland. In addition, sedimentary basins are known to exist in off-shore areas adjacent to the Australian coast. The individual basins range in area from 10,000 to 1,760,000 square kilometres and contain marine and continental sedimentary rocks ranging in maximum thickness from 300 to about 10,000 metres and including rocks of all ages from Proterozoic to Tertiary.

The main Australian deposits of black coal are in eastern Queensland and New South Wales. Most are Permian in age, although the deposits at Ipswich in Queensland are Triassic, and they predominantly have a bituminous rank; both coking and non-coking types occur. The extensive brown coal deposits of Victoria were formed during the Tertiary Period and are used to produce electricity for that State. The Late Triassic sub-bituminous coal at Leigh Creek is used to produce electricity in South Australia and Permian sub-bituminous coal is mined at Collie in Western Australia.

Crude oil and natural gas have been found in a number of sedimentary basins. In the Bowen-Surat Basin, Queensland, small commercial deposits of oil exist at the Moonie, Alton, Bennett and Major fields, and commercial deposits of natural gas exist in the Roma, Surat and Rolleston areas. Gas from the Roma area is used to supply Brisbane. Small gas reserves are present at Gilmore in the Adavale Basin. Most of the oil reservoir rocks are of Lower Jurassic age, and the gas reservoir rocks are of Mesozoic and Permian age. In the Gippsland Basin, offshore from Victoria in Bass Strait, oil in commercial quantities has been discovered in the Kingfish, Halibut, Tuna, Barracouta and Mackerel fields and commercial natural gas in the Marlin, Barracouta, Snapper and Tuna fields. Cretaceous and Tertiary strata are the reservoir rocks. Eastern Victoria and Melbourne are now supplied with gas from Marlin and Barracouta fields; oil is being piped from Kingfish, Halibut and Barracouta. Commercial deposits of natural gas were discovered in the Cooper Basin, South Australia at Gidgealpa, Moomba, Daralingie, Toolachee, Merrimelia, Della, Strzelecki, Mudrangie, Moorari, Coonatie, Fly Lake, Big Lake, Dullingari, Brumby, Kanowana and Burke, and gas and oil at Tirrawarra, Moorari, Fly Lake and Brolga, all in South Australia, and gas accumulations at Roseneath and Epsilon, Queensland. The reservoir rocks are of Permian age. In the Carnarvon Basin, Western Australia, commercial crude oil, mainly in the Cretaceous formations, and also to a lesser degree in the Jurassic rocks, is being produced from Barrow Island. Offshore, on the north-west continental shelf, major gas deposits have been discovered at Scott Reef, Rankin, Goodwyn, Angel and North Rankin; oil was discovered at Rankin, Legendre, Madeleine, Eaglehawk, Egret, Lambert, Dockrell and Goodwyn but these are at present non-commercial. Further south, onshore in the Perth Basin, natural gas in commercially significant quantities was discovered in the Yardarino, Gingin, Dongara, Mondarra and Walyering areas, the reservoir rocks being of Lower Jurassic, Lower Triassic and Permian ages. High pressure natural gas was encountered in the offshore Bonaparte Gulf Basin in the Petrel, Tern and Puffin prospects. Natural gas was discovered in commercial quantities in formations of Ordovician age at Mereenie and Palm Valley in the Amadeus Basin, Northern Territory. These are not yet being exploited but several proposals are under consideration. The gas accumulation at Mereenie is underlain by oil in the same Pacoota Sandstone reservoir.

The most important non-metallic minerals are asbestos, clays, sand and gravel, limestone, gypsum, salt and silica.

Opal is found in the flat-lying sedimentary beds of the Great Artesian Basin in Queensland, New South Wales and South Australia and was formed during the Tertiary Period. The other important gemstone produced is sapphire from alluvial wash near Inverell and Glen Innes in New South Wales and Anakie in Queensland.

A table showing most of the larger mineral deposits now being mined in Australia according to the age of the geological formation in which they are found is shown on page 931.

PRINCIPAL AUSTRALIAN MINERAL DEPOSITS

<i>Age of geological formation in which located</i>	<i>Metal or mineral</i>	<i>State or Territory</i>	<i>Locality</i>
Precambrian (more than 570 million years old)	Copper	Queensland	Mount Isa, Gunpowder
	Gold	Northern Territory	Tennant Creek
		Western Australia	Kalgoorlie and other localities
	Iron	South Australia	Middleback Ranges
		Western Australia	Yampi Sound and Pilbara
	Lead-silver-zinc	New South Wales	Broken Hill
Palaeozoic (between 235 and 570 million years old)		Queensland	Mount Isa
	Nickel	Western Australia	Kambalda-Windarra- Scotia-Nepean
	Black coal	New South Wales	Hunter Valley, Lithgow, South Coast
		Queensland	Bowen Basin, Blair Athol
		Western Australia	Collie
	Copper	New South Wales	Cobar
	Copper-gold	Queensland	Mount Morgan
		Tasmania	Mount Lyell
	Iron	Tasmania	Savage River
	Lead-silver-zinc	Tasmania	Rosebery
	Tin (lode)	Queensland	Herberton
		New South Wales	Ardlethan
Mesozoic (between 65 and 235 million years old)		Tasmania	Renison, Luina and north-east of State
	Tungsten	Tasmania	King Island and north-east of State
	Black coal	Queensland	Ipswich, Callide
		South Australia	Leigh Creek
	Manganese	Northern Territory	Groote Eylandt
	Bauxite	Queensland	Weipa
		Northern Territory	Gove
		Western Australia	Darling Range
	Brown coal	Victoria	Gippsland
	Mineral sands	New South Wales	North coast
		Queensland	South coast
		Western Australia	South-west coast
Cainozoic (less than 65 million years old)	Nickeliferous laterite	Queensland	Greenvale
	Tin (alluvial)	New South Wales	Tingha
		Queensland	Herberton
		Tasmania	North-east of State

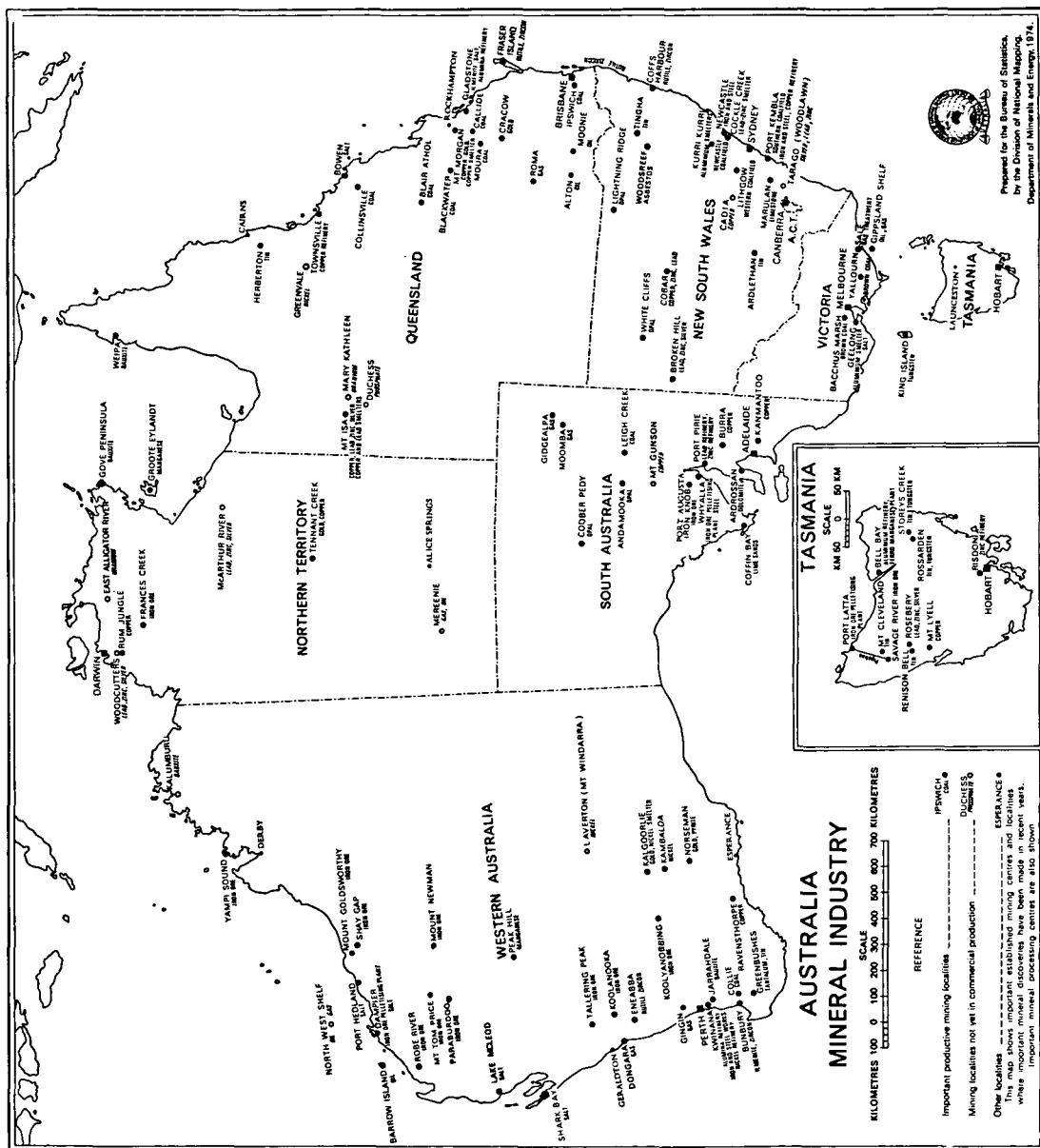


PLATE 55

Mineral resources

Australia is self-sufficient in most minerals of economic importance and much more than self-sufficient in some. The following table summarises, in a general way, known reserves and production of the principal metals and minerals in relation to Australian consumption of these commodities and present export availability. Many qualifications are necessary to a simple summary of this kind, and the table should be read in conjunction with the following detailed notes on principal minerals.

RESERVES OF MINERALS: AUSTRALIA

(Source: Bureau of Mineral Resources, Geology and Geophysics)

<i>Production</i>	<i>Reserves adequate</i>	<i>Reserves uncertain</i>	<i>Reserves negligible</i>
Production sufficient for domestic demand and exports	Aluminium (bauxite) Barite Bismuth Cadmium Coal (black) Copper Gold Gypsum Iron ore Lead Manganese ore (metallurgical) Natural gas Nickel Opal Salt Silver Thorium (monazite) Tin Titanium (ilmenite and rutile) Tungsten Zinc Zirconium (zircon)	Antimony Beryllium Glass sands Talc Tantalum	
Production sufficient for domestic demand	Clays (except light grade china clay) Coal (brown) Dolomite Felspar		
Production not sufficient for domestic demand	Asbestos (chrysotile) Lithium Phosphate Sulphides (as source of sulphur) Limestone	Abrasives Arsenic Bentonite China clay Chromium Cobalt Crude oil Diatomite Fluorite Magnesite Mercury Mineral pigments Molybdenum Platinum Potassium salts Sillimanite	
Production nil	Vanadium	Diamonds Graphite Manganese ore (chemical) Vermiculite	Asbestos (crocidolite) Borates Nitrates Sulphur

Individual minerals

NOTE. For further information on recent developments see pages 978-80.

Bauxite. As a result of discoveries at Weipa, Queensland, Gove, Northern Territory, and in the Darling Range and Kimberley area in Western Australia, Australia's reserves of bauxite are known to be very large, perhaps the largest in the world. Total reserves in the Weipa area are believed to be in excess of 3,000 million tonnes, while proved reserves at Gove are reported to contain 250 million tonnes of bauxite. In the Darling Range, reserves of economic grade bauxite are estimated to be about 1,000 million tonnes spread over several locations. Another significant deposit of over 200 million tonnes has been proved in the Mitchell Plateau area in the Kimberley District of Western Australia.

Coal. Australia has coal resources of all types adequate to provide for future domestic requirements and a substantial export surplus. Australia's coal reserves are concentrated mainly in the mainland eastern States. The bituminous coal is located mainly in New South Wales and Queensland; Victoria has very substantial brown coal reserves in the Latrobe Valley. The value of coal production in 1973 was second only to iron ore, as was the value of coal exports. Reserves of black coal in Eastern Australia were estimated in 1973 to be not less than 200,000 million tonnes.

Copper. The principal deposit of this metal is at Mount Isa, Queensland where ore reserves were estimated at 141 million tonnes in 1972. Other important deposits are situated at Cobar, New South Wales; Mount Morgan and Gunpowder, Queensland; Mount Lyell, Tasmania; Kanmantoo and Mount Gunson, South Australia; and at Tennant Creek, Northern Territory. Copper concentrates are produced as by-products of nickel concentrate production at Kambalda, Western Australia; silver-lead-zinc concentrate production at Broken Hill, New South Wales; tin concentrate production at Luina, Tasmania and lead concentrate production at Rosebery, Tasmania.

Crude Oil. The aggregate recoverable reserves of crude oil in Australia at the end of 1973 were estimated to be 260 million cubic metres. The largest reserves (216 million cubic metres) are in the offshore Gippsland Basin fields (Barracouta, Marlin, Halibut, Kingfish, Tuna, Mackerel), Victoria, followed by those in the Barrow Island and Pasco Island fields in the Carnarvon Basin, Western Australia (27 million cubic metres), the Mereenie field in the Amadeus Basin, Northern Territory (9.5 million cubic metres), the Tirrawarra, Moorari and Brolga fields in the Cooper Basin, South Australia (7.0 million cubic metres), the Moonie, Alton and Bennett fields in the Surat Basin, Queensland (413,000 cubic metres) and in the Dongara and Yardarino fields in the Perth Basin, Western Australia (210,000 cubic metres). To the end of 1973 the cumulative production of crude oil in Australia accounted for 78 million cubic metres representing a 23 per cent depletion of the initial estimates of reserves in all crude oil accumulations in Australia.

The Queensland oil reserves, mainly those in the Moonie field, are depleted by nearly 88 per cent, those in the Carnarvon Basin fields by 35 per cent and the offshore Gippsland Basin reserves by 21.7 per cent.

Gold. Australia's gold resources are heavily concentrated in Western Australia, mainly in the Kalgoorlie-Coolgardie area, but small deposits of gold-bearing ore occur in all States. In addition, gold is commonly obtained as a by-product of other mining activities, particularly copper mining. Economic gold ore reserves at Kalgoorlie were estimated at 5.3 million tonnes in late 1973.

Iron ore. Very extensive deposits of iron ore have been discovered, establishing Australia as one of the most important iron ore provinces in the world. The largest deposits are located in the Hamersley and Ophthemia Ranges in the Pilbara region of north-west Western Australia, and are being worked at Mount Tom Price, Paraburdoo, Mount Whaleback, and Robe River. Other commercially important deposits of iron ore are situated in the Savage River area of Tasmania, in the Middleback Ranges of South Australia, and in the Mount Goldsworthy, Shay Gap, Yampi Sound, and Koolyanobbing areas in Western Australia. These deposits are adequate to supply the estimated needs of the Australian iron and steel industry far into the future, as well as providing a large export availability. Total Australian reserves with an iron content greater than 55 per cent are estimated to be at least 24,400 million tonnes.

Lead-zinc. Australia has been a major producer of lead and zinc since the discovery of ore at Broken Hill, New South Wales in 1883. Measured reserves of lead-zinc ore at Broken Hill currently exceed 16 million tonnes assaying more than 20 percent combined lead and zinc. Reserves at another major producing mine, Mount Isa in Queensland, are 55.6 million tonnes assaying 6.9 per cent lead and 6.3 per cent zinc. Preparations are now being made to start production from a new mine, the Hilton, near Mount Isa with reserves of 37.4 million tonnes of ore, assaying 7.7 per cent lead and 9.6 per cent zinc. Reserves at the Lady Loretta deposit, near Mount Isa, are 8.7 million tonnes of ore assaying 6.7 per cent lead and 18.1 per cent zinc. The capacity of the mine at Rosebery in Tasmania (reserves of 9.5 million tonnes, 5.6 per cent lead and 18.6 per cent zinc) has been increased. Development of the McArthur River deposit in Northern Territory (reserves of 200 million tonnes,

4 per cent lead and 9 per cent zinc) is dependent on the solution of complex metallurgical problems. A deposit discovered near Tarago, near Goulburn, N.S.W. will commence production towards the end of 1977; reserves are estimated at 9 million tonnes assaying 3.0 per cent lead, 7.5 per cent zinc and 1.5 per cent copper. Lead and zinc concentrates are being produced with copper concentrates at Cobar, New South Wales.

Manganese. Known reserves of manganese, exceed domestic requirements and Australia is a major exporter. The principal deposit is currently being worked at Groote Eylandt in the Gulf of Carpentaria.

Mineral Sands. Ores of titanium (rutile and ilmenite), zirconium (zircon) and thorium and rare earths (monazite) occur in mineral sands over extensive areas of the north and central coasts of New South Wales, the south and central coasts of Queensland, and the south-western coast of Western Australia and at Eneabba, 270 kilometres north of Perth. Resources are large by world standards and easily workable. Australia's reserves of rutile and zircon represent a large proportion of the world's reserves of these minerals. In 1972 Australia was responsible for about 98 per cent of the world's supplies of rutile, 80 per cent of zircon, 36 per cent of monazite and 25 per cent of ilmenite (excluding Canadian production of titaniferous slag).

Natural gas. The aggregated recoverable reserves of natural gas in the offshore and onshore accumulations were estimated at the end of 1973 at 832 thousand million (billion) cubic metres. Of this amount 12 billion cubic metres, or 1.5 per cent, have been produced; the remaining reserves at 1 January 1974 were, therefore, 820 billion cubic metres. Largest gas reserves are in four fields—Rankin, North Rankin, Goodwyn and Angel—in the Dampier Sub-basin (Carnarvon Basin) on the North-west Shelf, offshore from Western Australia. No firm plans have yet been announced for the development and utilisation of these substantial reserves. The next largest remaining gas reserves (220 billion cubic metres) are in the offshore Gippsland Basin, Victoria. Production commenced from here in 1969, and gas is supplied to Melbourne, Geelong and Ballarat—Bendigo areas and a Melbourne—Benalla—Wodonga—Albury pipeline is planned. The 96 billion cubic metres of gas reserves in the Cooper Basin, South Australia, had been committed for the supply of the Adelaide, South Australia and the New South Wales markets. The supply of the Adelaide market commenced in November 1969. The 1,370 kilometre pipeline to Sydney is now under construction. The relatively small gas reserves in the Roma area in Queensland and Dongara—Mondarra—Gingin area in Western Australia have been supplying the Brisbane and Perth—Pinjarra areas since 1969 and 1971 respectively.

Natural gas liquids. The Australian reserves of natural gas liquids, i.e. condensate and LPG (liquified petroleum gas), remaining at the end of 1973 were estimated at 208 million cubic metres. On the whole these reserves are distributed proportionately to the reserves of natural gas, the largest being in the North-west Shelf fields, followed by those in the offshore Gippsland Basin, then Cooper Basin, etc., but generally, the natural gas liquid (NGL) content of the North-west Shelf gas is considerably higher than that of gas accumulations elsewhere in Australia. A separate 'liquids' pipeline for the transmission of NGL and crude oil from the Cooper Basin fields to Red Cliffs near Port Pirie, South Australia, has been under consideration for some time.

Nickel. In the Kalgoorlie—Widgiemooltha area of Western Australia more than 30 nickel sulphide ore bodies have been found since the original discovery of nickel ores was made at Kambalda in 1966. Total ore reserves in the Kalgoorlie area are more than 34 million tonnes, averaging 2.8 per cent nickel. Other large but low-grade ore bodies have been found between Leonora and Wiluna; the largest of these is Mount Keith where ore reserves are estimated to be 330 million tonnes averaging 0.6 per cent nickel. In the Leonora—Wiluna area at Agnew the ore body is estimated to contain at least 40 million tonnes of ore averaging 2.2 per cent nickel.

A nickel refinery has been built at Kwinana, Western Australia, with an annual capacity of 15,000 tonnes which has now been expanded to 20,000 tonnes. A smelter built at Kalgoorlie with an annual capacity of 200,000 tonnes of nickel concentrate commenced operation in 1973. Use of bulk oxygen in the smelter is expected to increase throughput by 75 per cent.

Production from lateritic nickel deposits at Greenvale in Queensland is expected to commence in early 1975. The ore will be refined near Townsville. Other large, but at present uneconomic, deposits of this type are known at Wingellina, near the border of South Australia and Western Australia, at the Ora Banda district north-west of Kalgoorlie and at Marlborough in Queensland.

Phosphate. Major deposits of phosphate rock are known in north-west Queensland and in the Northern Territory with reserves exceeding 3,000 million tonnes. Production from the north-west Queensland deposits is now scheduled for 1975.

Tin. The main deposits of tin now being exploited are in the Herberton field inland from Cairns, Queensland; north-west and north-east Tasmania; in the Pilbara region and in the south-west of

Western Australia; and at Ardlethan and in the New England area, in New South Wales. As the result of exploration and expansion of known deposits in recent years, Australia is now a net exporter of this metal.

Tungsten. The main deposits of tungsten ores are in north-eastern Tasmania (wolfram) and on King Island (scheelite). Australia's own requirements are small, and production is principally for export. Australian production of tungsten concentrates could be doubled by the mid-1970s when the planned increases in production at King Island take effect. The Storeys Creek wolfram mine recommenced production in 1973 following an increase in the price of tungsten.

Uranium. Exploration and development work continued in the Alligator Rivers uranium province in the Northern Territory. The discovery of a new deposit, Jabiluka 2, was announced early in 1973, and substantial additions were made to reserves at the Ranger deposit as a result of further diamond drilling. Preliminary estimates suggest that at least 150,000 tonnes of uranium oxide will be proven in the four major deposits at Nabarlek, Koongarra, Ranger and Jabiluka.

Other important deposits have been outlined at Yeelirrie, Western Australia (46,000 tonnes uranium oxide) and at the Beverley deposit (15,900 tonnes uranium oxide) in the Lake Frome region, South Australia. At Mary Kathleen, Queensland, recoverable reserves have been estimated at almost 7,300 tonnes uranium oxide; no plans for reopening have as yet been finalised but it is estimated that recommissioning of plant, which has been on a care and maintenance basis for 10 years, will take 18 months.

There has been no production of uranium oxide since 1971 in Australia.

Administration

All mineral rights in Australia are vested in the Crown except on land which was granted before the Crown began to reserve mineral rights. In practice these private mineral rights are important only in the New South Wales coalfields. In the States, rights are held by the State Governments and in the Territories of the Commonwealth these rights are vested in the Australian Government. The Australian Government is able also to influence over-all development and production activity in the mineral industry by virtue of its statutory powers with respect to international trade, customs and excise, taxation, and loan raisings. Certain specially formed bodies such as the Joint Coal Board and the Australian Atomic Energy Commission have been given administrative responsibility in defined areas.

Control of mining

Each State or Territory has its own mining Acts or Ordinances and regulations governing the prospecting for and working of mineral deposits. Before the commencement of the Acts mentioned in the next paragraph these Acts, etc., were similar in principle, but different in detail. They all made provision for miner's rights to prospect and for small mining leases for mineral production. The principles embodied in these Acts, etc., were established many years ago when mining operations were generally small scale and labour-intensive. Although amendments had been enacted to modernise the legislation, it was generally inadequate for the large scale capital-intensive operations often involved with modern mineral development. For this reason a large enterprise may take the course of acquiring mining titles by negotiation with the appropriate Minister for Mines and having the agreed terms and conditions embodied in an Act of the State Parliament. This method of acquisition has been used in several cases where the leasing company undertook an obligation (such as the erection of a large treatment works) in return for leases over large areas for a long period, and has become more common in recent years (e.g. iron ore in Western Australia, coal and bauxite in Queensland, bauxite in the Northern Territory).

Two States have brought into operation new mining acts, i.e. *The Queensland Mining Act of 1968 to 1971* which commenced on 1 January 1972 and *The South Australian Mining Act, 1971* which commenced on 3 July 1972. These Acts are simpler and more suited to modern conditions than the mining acts which they replaced. Western Australia and New South Wales introduced Bills for new mining acts into their respective Parliaments in 1972. The New South Wales Act was passed in 1973 but had not become operative at the end of that year. The Western Australian Act lapsed at the dissolution of the Western Australian Parliament.

AREAS OCCUPIED UNDER MINING ACTS AND ORDINANCES(a)

('000 hectares)

Year (31 December)	N.S.W.(b)	Vic.	Qld(c)	S.A.(b)	W.A.	Tas.	N.T.(b)	Total
1969 . . .	565	246	1,055	39	595	22	38	2,560
1970 . . .	605	931	1,444	49	2,231	24	39	5,323
1971 . . .	464	498	1,589	53	3,165	25	41	5,835
1972 . . .	656	133	1,405	59	1,721	26	48	4,048
1973 . . .	(d)1,115	25	1,258	98	1,850	36	51	4,433

(a) Excludes areas held under special arrangements; see following text. (b) At 30 June. (c) Excludes lands held under miners' rights and dredging claims. (d) Figures not comparable with previous years; includes some new coal titles, as defined by the *Coal Mining Act 1973*.

Control of exploration

This section refers in general to the exploration for all types of mineral deposits in Australia. Additional information relating to the search for petroleum is set out in the following section.

As a result of the introduction of large-scale modern prospecting methods (particularly air-borne prospecting), the small prospecting areas referred to in the previous section were found to be unsuitable in some instances, and steps have been taken in the States and Territories to ensure the availability of large areas for prospecting by interested persons. Large areas may be made available by provision within the Mining Acts or Ordinances for the issue of authorities to prospect over an area defined by a written agreement which also sets out provisions as to the amount of money to be spent, methods of prospecting, tenure of the agreement, etc.

The tenure of such areas is limited, usually to one or two years only, and, if renewed for a further period, is only over an area selected from the larger area as a result of work done during the life of the initial agreement. It does not give the holder any rights over, or authorities to prospect on, land already held under a mining title within the agreed area. Unless specifically stated in an agreement, the discovery of minerals, whether inside or outside an area covered by an authority to prospect, gives the discoverer no legal rights except the right to apply for a mining lease over the area in which the discovery was made. Suitable prospects are converted to mining tenements by making application for lease under the appropriate mining Act.

Control of petroleum exploration

On-shore. In Australia all petroleum is the property of the Crown. Consequently, full control of petroleum mining rights is vested in the Government or Administration of each State or Territory. Any company, organisation or individual proposing to undertake petroleum exploration or development must first satisfy the Government concerned that the necessary financial and technological resources are available to carry out the operation.

There are three main types of petroleum titles:

- (a) the permit, covering initial geological, geophysical and exploration drilling;
- (b) the licence (in Victoria only), which covers detailed surveys and drilling; and
- (c) the lease, which covers development operations and production.

Further details of the petroleum legislation are given in Year Book No. 55, pages 996-7. The States of Western Australia and South Australia recently issued some revisions to their on-shore legislation, for details of which direct reference should be made to the State concerned.

Off-shore. The *Petroleum (Submerged Lands) Act 1967-1973* is the instrument whereby the control and safeguarding of the exploration and exploitation of petroleum resources on the territorial sea-bed and on the continental shelf are assured. Complementary legislation has been passed by each State Government and by the Australian Government.

The legislation provides for a two-stage system of titles: the exploration permit, which covers all forms of exploration including drilling, and the production licence, which covers development and exploration. Royalty is generally shared between State and Australian Governments on a 60 : 40 basis; however, overriding royalty is payable to the State under certain conditions. Mineral royalty receipts of governments under these Acts are included in the table on page 938.

The table following shows details of areas occupied under both on-shore and off-shore petroleum exploration and development titles at 31 December 1970, 1971, 1972 and 1973.

AREAS OCCUPIED UNDER PETROLEUM EXPLORATION AND DEVELOPMENT TITLES

Year (31 December)	N.S.W.	Vic.	Qld	S.A.(a)	W.A.	Tas.	N.T.(a)	Total
ON-SHORE AREAS (square kilometres)								
1970 . .	227,624	65,547	1,037,292	604,830	n.a.(b)	1,655	159,981	n.a.
1971 . .	196,145	47,892	885,596	569,710	n.a.(b)	596	149,530	n.a.
1972 . .	86,728	51,442	1,296,085	567,187	n.a.(b)	..	149,530	n.a.
1973 . .	158,164	34,582	695,838	599,293	n.a.(b)	16	163,504	n.a.
OFF-SHORE AREAS (5 minute blocks) (c)								
1970 . .	643	1,189	2,918	3,425	8,808	2,314	3,626	22,923
1971 . .	782	1,178	2,918	3,089	8,727	1,703	3,534	21,931
1972 . .	503	1,178	2,918	3,089	10,171	1,498	3,535	22,892
1973 . .	433	1,178	2,918	3,089	9,828	1,498	4,283	23,227

(a) At 30 June. (b) Available only in terms of 5 minute blocks of which there were 6,510 at 31 December 1971, 8,036 at 31 December 1972 and 7,260 at 31 December 1973. (c) Area bounded by 5 minutes of latitude and 5 minutes of longitude; figures include partial blocks.

Mineral royalties

The collection by governments of royalties for the production of minerals within their area of authority is an internationally accepted practice. In Australia the responsibility for mineral royalties is largely a State concern, and all States currently collect some form of mineral royalty payments. In the past most States have relied on an established system of standard rates which were uniform for all producers of any particular mineral in the State concerned. These charges were either a fixed monetary amount per tonne (e.g. 5c per tonne on gypsum mined in New South Wales) or an *ad valorem* royalty (e.g. 1.5 per cent of gross value of gold produced in New South Wales).

In recent years there has been an important basic change in the system of establishing royalty commitments, and it is now quite common for State Governments to negotiate special royalty rates with companies which are seeking mineral leases for large scale developments. These royalty rates may vary, depending on whether production is for export or for domestic processing. The rates for a particular mineral may also vary between producers. Important examples of this type of royalty agreement are the iron ore development agreements in Western Australia and coal development agreements in Queensland. Mineral royalties received by Governments in recent years are shown in the table below.

MINERAL ROYALTY RECEIPTS: GOVERNMENTS
(\$'000)

	1968-69	1969-70	1970-71	1971-72	1972-73
New South Wales(a)	9,795	13,558	17,819	10,237	9,592
Victoria(b)	687	2,736	12,239	16,875	18,026
Queensland(a)	1,688	3,039	5,483	3,805	3,525
South Australia	1,254	1,557	1,798	1,821	1,807
Western Australia	11,001	15,700	22,347	25,247	27,266
Tasmania(c)	251	424	410	489	498
Northern Territory	283	449	431	634	910
Australian Government(d)	11	492	5,024	7,567	7,896
Total	24,971	37,953	65,552	66,676	69,521

(a) Includes royalty on sand and gravel from Crown lands. (b) Includes royalty on brown coal paid by State Electricity Commission and royalties received under the *Petroleum (Submerged Lands) (Royalty) Act 1967*. (c) Includes rent and fees from mineral lands and royalties on iron ore. (d) Includes royalties received under the *Petroleum (Submerged Lands) (Royalty) Act 1967*.

Control of Exports

The Australian Government maintains export controls over certain metals, petroleum and petroleum products and all raw and semi-processed minerals. These controls are administered under the authority of the Customs (Prohibited Exports) Regulations as amended from time to time by Statutory Rules. The authorities having jurisdiction over such exports are set out below together with listings of the goods subject to control. A clearance to export is needed in each case.

Minister for Minerals and Energy—An amendment to the Customs (Prohibited Exports) Regulations on 22 February 1973 (Statutory Rule No. 39 of 1973), and further amended by Statutory Rules 1973/248 and 1974/46, provides that the exportation from Australia of the following goods is prohibited unless approval in writing is issued by the Minister for Minerals and Energy or by an authorized person.

- (a) ores containing copper or tin, whether or not they have been subjected to processing or treatment; mineral or metallic substances produced in the course of processing or treatment of those ores; copper anodes, copper cathodes; copper ingots, copper rods, copper scrap and copper refinery shapes in the form of ingots, wire bars, billets, cakes, rolling blocks or ingot bars; copper alloys in the form of ingots, billets, cakes, rolling blocks or ingot bars and copper alloy scrap; goods consisting wholly or principally of copper, or copper alloy, or both copper and copper alloy, whether refined or not; goods containing copper, or copper alloy or both copper and copper alloy, whether refined or not, if the value of the copper or copper alloy or the value of the copper and the copper alloy in the goods is greater than the value of the other substances constituting the goods; substances (being residues, speiss, slag, dross, scale, sweepings, ash, sludge, slime, dust and wastes) produced in the course of the processing and treatment of copper and copper alloys; copper sulphate; copper oxide; refined tin in the form of ingots or in any other refinery form;
- (b) alumina;
- (c) petroleum and petroleum products;
- (d) all other minerals including those other minerals that have been subjected to processing or treatment; substances produced in the course of processing or treatment of those other minerals but not including refined products obtained by or from processing or treatment of those other minerals and goods into which products, whether refined or not, obtained by or from processing or treatment of those other minerals have been converted.

In addition, the export of metals and minerals of atomic energy significance are also controlled, viz.: minerals containing uranium and thorium, uranium, thorium, beryllium and lithium metals, compounds and alloys; hafnium-free zirconium metal, alloys and compounds, nickel metal in certain forms.

Department of Agriculture—phosphate rock, phosphate and superphosphate, and fertilisers containing phosphate or superphosphate.

Joint Coal Board

The Joint Coal Board was established in 1946 under joint legislation of the Australian Government and of the State of New South Wales to carry out special administrative functions in regard to the New South Wales black coal mining industry. A summary of these functions is given below.

- (i) To ensure that coal is produced in the State of New South Wales in such quantities and with such regularity as will meet requirements throughout Australia and in trade with other countries;
- (ii) to ensure that the coal resources of the State are conserved, developed, worked and used to the best advantage in the public interest;
- (iii) to ensure that coal produced in the State is distributed and used in such manner, quantities, classes and grades, and at such prices as are calculated best to serve the public interest and secure the economical use of coal and the maintenance of essential services and industrial activities; and
- (iv) to promote the welfare of workers engaged in the coal industry in the State.

Queensland Coal Board

The Queensland Coal Board carries out research and sampling tests of Queensland coals. It also makes funds available to colliery proprietors for equipment and makes grants and/or loans for the provision of amenities for employees and for communities in coal mining districts.

Australian Atomic Energy Commission

During 1953, legislation was enacted to set up an Atomic Energy Commission which is responsible, in an overall sense, for the production and utilisation of uranium in Australia. This Act, the *Atomic Energy Act 1953*, superseded the *Atomic Energy (Control of Materials) Act 1946*, but retains a provision of that Act which provides for the control of substances which could be used for production or use of atomic energy.

The functions of the Commission fall under two main headings. Firstly, it is responsible for undertaking and encouraging the search for and mining of uranium and is empowered to co-operate with the appropriate authorities of the States in connection with these and related matters. Secondly it is authorised to develop the practical uses of atomic energy by constructing and operating plant for this purpose, carrying out research and generally fostering the advancement of atomic energy technology. The Commission operates under the direction of the Minister for Minerals and Energy.

Government assistance

The Australian Government and the various State Governments provide assistance to the mineral industry in a variety of ways. The main forms of assistance are discussed below.

Australian Government assistance

Assistance provided by the Australian Government takes the form of income taxation concessions, subsidies, bounties, and technical assistance mainly through the work of the Bureau of Mineral Resources and the Commonwealth Scientific and Industrial Research Organization. A table showing direct Australian Government payments to sectors of the mineral industry is included on page 942.

Income taxation concessions. One-fifth of the net income derived from mining for prescribed minerals in Australia or Papua New Guinea is exempt from tax. Principal minerals to which this concession applies are as follows: asbestos, bauxite, radio-active ores, rutile and zircon; and ores of copper, nickel and tin.

Income derived from mining principally for gold in Australia or Papua New Guinea is exempt from tax. The exemption is also available in respect of income derived from mining principally for gold and copper if the value of the gold obtained is not less than 40 per cent of the value of the total output.

Special deductions for capital expenditure incurred in the discovery and mining of petroleum are allowable to a company deriving income from the sale of petroleum, and products of that petroleum, mined by the company in Australia or Papua New Guinea. A company is entitled to these deductions only when it produces Australian petroleum in commercial quantities. The general effect of the deductions is to free the proceeds from the sale of Australian or Papua New Guinean petroleum and its products from tax until all allowable capital expenditure has been fully recouped.

Capital expenditure allowable to petroleum exploration companies includes, broadly, the cost of exploratory surveys, drilling and well-head plant, access roads and expenditure on housing and welfare.

A company mining or prospecting for minerals other than petroleum and gold may also be allowed special deductions for capital expenditure. Broadly, allowable capital expenditure includes expenditure on exploration and prospecting, preparation of a site for extractive mining operations, buildings, other improvements and plant necessary for those operations, access roads, certain treatment plant and housing and welfare.

The allowable capital expenditure of a general mining company may be deducted over the life of the mine, or twenty-five years, whichever is the lesser. Alternatively, the mine owner may elect to have the allowable capital expenditure deducted in the year it is incurred or, where appropriations have been made for such expenditure to be incurred in the following year, the deduction may be allowed in the year of the appropriation. Annual deductions for depreciation on mining plant may be allowed in lieu of spreading the cost over the life of the mine. Expenditure on housing and welfare may, at the option of the mine owner, be allowed over the life of the mine, or five years.

Special deductions are allowable for capital expenditure incurred on certain transport facilities used primarily and principally in relation to minerals mined in Australia, for the transport of raw minerals and certain specified products obtained from the processing of such minerals, or for transporting petroleum between the oil or gas field and a refinery or other terminal. The special deduction applies to expenditure incurred on a railway, road, pipe-line or similar transport facility. Allowable expenditure on transport facilities is deductible in equal annual instalments over a period of ten years.

Petroleum search subsidy. The petroleum search subsidy scheme, introduced in 1957, was terminated on 30 June 1974. During the years that the scheme was in operation, various amendments to the Act and Regulations altered the rates of subsidy and the types of operations to which subsidies were applicable. The last amendment to the Act, introduced in 1969, extended the duration of the Act

to 30 June 1974, and restricted the general availability of subsidy to onshore areas; operations in offshore areas were only subsidised if there was an Australian financial interest in the operation and the rate of subsidy approved had regard to the extent of that interest. In March 1972, the subsidy for approved onshore geophysical operations was increased to 50 per cent of acceptable costs of the operation. For all other approved operations the maximum subsidy was 30 per cent of acceptable costs. Details of amendments to the Petroleum Search Subsidy Act are given on page 1001 of Year Book No. 55. Subsidy payments made under the Act for the years 1969 to 1973 are shown in the table on page 942.

Pricing of Australian crude oil. Early in 1965 the Tariff Board conducted a public inquiry to determine an appropriate price for Australian crude oil, having regard to the Australian Government's desire to encourage the search for oil and the consequent need to offer sufficient incentive to exploration companies. At the same time the Government indicated that it was anxious to prevent or minimise increased costs of petroleum products to consumers and to ensure that refineries using Australian crude oil were not detrimentally affected in relation to other refineries. Evidence was heard from oil exploration, marketing and refining interests, government officials, coal and power interests, and major users of refined petroleum products. The Tariff Board recommended at that time that Moonie crude oil should be valued at \$2.69 a barrel at the nearest refinery centre, which included a variable differential related to the quality of the oil and an incentive of 22.4 cents per barrel. The Government adopted the Tariff Board's recommendations, and raised the incentive margin to 67 Australian cents a barrel; this margin applied to all Australian crude oil producers.

To ensure that indigenous crude oil is used to the maximum extent in Australian refineries, the Government also adopted the Tariff Board's recommendation to impose penal import duties of 0.8 cents a gallon on crude oil and 2.4 cents a gallon on motor spirit to be paid by the companies which do not take their share of local crude oil. The share of local crude to be taken was based on the importer's share of total imports of refinery feedstock or refined products or both.

Under these arrangements the price of Moonie crude was \$3.14 a barrel delivered Brisbane; and Barrow Island field when it commenced production in April 1967 was \$3.24 a barrel delivered Kwinana. This pricing structure was to remain operative until 17 September 1970.

However, the discovery of very large crude oil reserves in the Gippsland Shelf fields revealed that this pricing structure could result in the Australian consumer paying more for indigenous petroleum products than for similar products refined from imported crude oils. Following negotiations with the Australian Government the Gippsland Shelf operators agreed to forgo the \$0.67 a barrel incentive, plus a further \$0.05 per barrel. This applies from commencement of production in October 1969 to 17 September 1970. As from 18 September 1970, the price of all Australian crude oils has been based on 'import parity' as at 10 October 1968, the date on which the new arrangements were announced by the Prime Minister in Parliament. This pricing structure is for a 5 year period from 18 October 1970.

Under this agreement the Gippsland crude oil is priced in the following manner:

	<i>per barrel</i> \$
Weighted average posted price as at 10 October 1968 of principal crudes imported into Australia	1.62
less weighted average discounts as at 10 October 1968	0.26
	1.36
plus weighted average overseas freights as at 10 October 1968	0.46
Wharfage and other charges as at 10 October 1968	0.07
	1.89
less a deduction for coastal freight	0.09
	1.80

To this the quality differential of approximately \$0.26 per barrel is added. The quality differential varies according to changes which occur in the quality of the oil produced.

Moonie crude oil on the same basis, for the five-year period is \$2.15 per barrel f.o.b. Brisbane, since the coastal freight deduction of 9 cents per barrel does not apply.

Barrow Island crude is the basic \$1.89 per barrel plus a quality differential of 34 cents, giving the total of \$2.23 per barrel f.o.b. Kwinana.

The Government has announced that the absorption of Australian crude oil by Australian refineries will be Government policy until September 1980. The allocations to refining and marketing

companies are now based on the sales volume of certain products, and the associated penal duties on imports made by companies not taking up their allocations have been increased to 7.5 cents per gallon on motor spirit, 5 cents per gallon on other refined products and 2 cents per gallon on crude oil.

The Government has also announced that, should the production of Australian crude oil exceed the capacity of the refiners to absorb indigenous crude, the available market will be shared between all producing companies on a formula based on the reserves of each company. Export of the excess crude oil will be permitted.

Assistance to the gold-mining industry. Assistance to the gold-mining industry by subsidy was introduced at a time of rising costs in the industry and fixed official world price for gold. Because many producers were faced with the likelihood of closing down, the Government decided to subsidise marginal producers in Australia and Papua New Guinea. Under the *Gold-Mining Industry Assistance Act* 1954 a producer, the value of whose gold output exceeded 50 per cent of the total value of his mine output, was eligible for assistance, subject to certain conditions, on the production of gold from 1 July 1954. The assistance scheme has been reviewed on a number of occasions since the Act was originally passed, and some liberalisations have been approved, including increases in the rates of subsidy payable authorised in amendments passed in 1957, 1959, 1965 and 1972.

Under the Act in 1973 the subsidy payable to small producers whose annual deliveries did not exceed 500 fine oz was \$6 per fine oz, irrespective of cost of production. For large producers, subject to certain provisions, the rate of subsidy payable was an amount equal to three-quarters of the excess of the average cost of production over \$27 per fine oz, with a maximum amount of subsidy of \$12 per fine oz. A producer whose deliveries during the year exceeded 500 fine oz could elect to be treated as a small producer. In this case the subsidy rate payable per fine oz on total deliveries was \$6 reduced by 1c for each fine oz by which deliveries exceeded 500 fine oz. The benefit under this provision terminates when deliveries in a year reach 1,100 fine oz. Where a producer received an amount in excess of \$31.25 per fine oz on market sales of gold, the subsidy payable was, with effect from 1 January 1972, reduced by fifty per cent of the amount of the excess. Increases in the market price of gold since 1972 have resulted in a reduction in subsidy payments to producers in 1973 compared with previous years.

Payments under the Act will apply to production until 30 June 1975. The amounts paid to gold producers in recent years are shown in the table below.

Assistance to the producers of sulphuric acid and iron pyrites. The *Sulphuric Acid Bounty Act* 1954-1971 and the *Pyrites Bounty Act* 1960-1971 expired on 31 May 1972. The Acts provided for payment of bounty on sulphuric acid produced from prescribed Australian materials, and to producers of iron pyrites. Payments under these Acts for recent years are shown in the table below.

Payments to producers of phosphate fertilisers. The *Phosphate Fertilisers Bounty Act* 1963-1971 provides for a bounty to be paid on superphosphate and ammonium phosphate manufactured and used in Australia as a fertiliser. (This includes approved trace elements, compounds or substances when added to superphosphate). Bounty is payable on the soluble content of phosphorus pentoxide. A standard grade of superphosphate containing between 19.5 and 20.5 per cent soluble content of phosphorus pentoxide qualifies for full bounty of \$11.81 per tonne. Outside this range, bounty is payable at \$59.05 per tonne of contained phosphorus pentoxide. The intention of this Act is to assist consumers of phosphate fertilisers (primary producers). The Act is due to expire on 31 December 1974. Payments under the Act, are set out in the following table.

**AUSTRALIAN GOVERNMENT PAYMENTS TO THE MINERAL INDUSTRY
AND TO THE MANUFACTURING INDUSTRY FOR PRODUCTS OF MINERAL
ORIGIN; AUSTRALIA**

(\$'000)

Year	Petroleum exploration (a)	Gold mining(b)	Pyrites mining(c)	Sulphuric acid production (d)	Phosphate fertiliser production (e)
1969 . . .	14,911	1,077	..	988	31,665
1970 . . .	11,237	3,278	90	740	45,820
1971 . . .	8,468	2,162	568	489	40,815
1972 . . .	8,422	1,185	962	527	49,137
1973 . . .	9,611	49	..	..	66,962

(a) *Petroleum Search Subsidy Act* 1959-69. Includes payments in Papua New Guinea; see also the table on page 973. (b) *Gold-Mining Industry Assistance Act* 1954-72. Includes payments in Papua New Guinea. (c) *Pyrites Bounty Act* 1960-1971. This Act expired on 31 May 1972. (d) *Sulphuric Acid Bounty Act* 1954-1971. This Act expired on 31 May 1972. (e) *Phosphate Fertilisers Bounty Act* 1963-1971.

Bureau of Mineral Resources, Geology and Geophysics. The functions of BMR are as follows:

- (i) as a primary function, to obtain, study, publish and provide basic geological and geophysical information necessary for the exploration and development of the nation's mineral resources; this to be done where appropriate in co-operation with State and Territorial authorities;
- (ii) to undertake experimental studies and research into geology and geophysics in order to support the function of obtaining basic information;
- (iii) to make basic investigations of the earth's magnetic and gravitational fields and in seismology and vulcanology;
- (iv) to complement the work of the State and Territorial authorities by undertaking geological and geophysical investigations into the occurrence and distribution of underground water;
- (v) to undertake geological and geophysical investigations on behalf of other Australian Government Departments and authorities including the provision of resident staff by arrangement with the Territories;
- (vi) to obtain basic information on, and review the mineral resources of Australia and its Territories; to study the various sectors of the mineral industry both in the national and international spheres; to publish and provide information about the mineral industry;
- (vii) to undertake such investigations in mining engineering and petroleum technology as are relevant to (i) and (vi) above;
- (viii) to prepare advice for Government on the mineral industry, including the exploration and development of mineral resources in the national interest;
- (ix) when directed by Government, to administer schemes for the assistance of sectors of the mineral industry and to undertake special mineral projects.

BMR comprises five branches under the Director: Operations, Mineral Resources, Geological, Geophysical, and Petroleum Exploration. The Operations Branch consists of four sections, Planning and Co-ordination, Publications and Information, Automatic Data Processing Applications and Administrative. It carries out central office functions, including planning and control of program, assessment of results, co-ordination of activities, liaison, distribution of information and provision of ADP services. The Mineral Resources Branch comprises the sections Mineral Economics, Mining Engineering, and Petroleum Technology, and is concerned largely with those aspects of BMR's work which involve studies of the mineral industry as a whole, and the preparation of advice and reviews for the Government, industry and the public. The Geological and Geophysical Branches are responsible for the principal field activities of BMR, and the operation of observatories, while the Petroleum Exploration Branch is concerned with the administration of the *Petroleum Search Subsidy Act* 1959-1969 and the assessment of sedimentary basins in Australia and its Territories. The establishment of BMR is 672 officers (at 31 July 1974) and includes 262 professional officers (geologists, geophysicists, chemists, engineers and mineral economists). The budget for the financial year 1973-74 was \$20.31 million of which \$10 million was for payment under the *Petroleum Search Subsidy Act* 1959-1969.

BMR maintains laboratories in Canberra and Darwin which are engaged on geochemical, geochronological and petroleum technological studies and basic research into the design and testing of geophysical equipment. It also maintains geophysical observatories at Toolangi, Mundaring, Port Moresby, Mawson (Antarctica), and Macquarie Island. The geophysical observatories are engaged in magnetic, ionospheric, and seismic investigations and are base stations for field operations.

State Government assistance

In addition to free assays and determinations of rocks and minerals carried out for prospectors by the Mines Departments of the States and Territories, technical officers of these departments provide advice to the mining and allied industries where required, carry out field examinations of mining prospects, advise on exploration and development, select sites for water supply, and in general give a free technical service to the mining industry.

New South Wales. The State Mines Department renders scientific, technical and financial assistance to the mining industry. Grants are made to cover up to half the cost of prospecting and drilling operations. These grants are repayable if sufficient pay minerals are discovered or if certain other conditions are met. Loans at low interest rates may be made to prospectors and miners for the purchase of plant and machinery. A quantity of equipment is also available for hire in several localities. The Department has itself undertaken a program of contract drilling to investigate the existence of mineral deposits in the State (including the testing and proving of coal resources). Expenditure on financial assistance in 1972-73 amounted to \$537,766 including \$298,795 on the Department's own drilling program.

Victoria. The Mines Department conducts geological and mineral surveys and produces geological maps and issues scientific and technical reports thereon. Extensive rotary, percussion and auger drilling operations are carried out and in conjunction with these, sedimentary basin studies are made to evaluate petroleum, mineral and groundwater potential. A comprehensive library and a geological museum are maintained and a core library retains cores and cuttings from drilling operations. The administration of petroleum and pipeline legislation ensures the conduct of all petroleum exploration and production operations by private operators, onshore and offshore, in a safe and effective manner. Technical and drilling assistance and loans or grants are available for mineral exploration and prospecting and for approved development operations. Six stamp batteries provide an ore crushing service to enable test crushings to be made at nominal cost. Information is available on mining law and mineral statistics. Assays of ores, analytical services, advice on metallurgical treatments, industrial pollution and chemical problems are available together with information on the manufacture, handling and use of explosives and inflammable liquids. Financial assistance is available to municipalities to reclaim mine-damaged land, in areas where a Reclamation Committee recommends such action.

Queensland. The Department of Mines provides assistance to mining by way of geological services, grants for construction and maintenance of roads in mining areas, repayable advances or subsidies for mine development, hiring of equipment, and assistance to prospectors. The Department maintains a concentration plant for tin ores at Irvinebank, an assay office at Cloncurry, a battery for treatment of gold-bearing ores at Charters Towers, and diamond drilling plants in various parts of the State.

South Australia. The Department of Mines provides the following services and facilities to the mineral industry: (i) drilling and testing of mineral deposits, geophysical investigations, well logging development of sub-surface water supplies for farming, pastoral, irrigation, and mining purposes; (ii) geological examination of mineral deposits, ground water supplies, dam foundation and drainage problems, and publication and issue of geological bulletins and maps. It also provides, through the Australian Mineral Development Laboratories, facilities for chemical, metallurgical, analytical and assay investigations, testing and treatment of ores and minerals, and petrographic, mineragraphic and radiometric determinations. Pilot scale metallurgical and chemical treatment plants are maintained and operated for the development of mineral extraction processes.

Western Australia. Prospectors receive assistance of either \$15 or \$17.50 a week according to the prospecting locality. North of the 26th parallel and within a defined area south of this, lying largely outside the agricultural areas, assistance is given to the extent of \$17.50 a week. In the remainder of the State prospectors receive \$15 a week. Provision is also made for the supply of some tools required for prospecting. There are sixteen State batteries operating intermittently throughout the goldfields for the treatment of ore from prospectors and small mine-owners at a nominal charge. A cartage subsidy is also granted to such operators sending gold and lead ores to State batteries for treatment. Provision is made for loans to mine-owners who require assistance to develop mines.

Tasmania. The Department of Mines provides financial assistance to mining lessees for the purchase of plant and machinery, for sinking, repairing or de-watering of shafts, for construction of dams and water races, for testing and proving a deposit of any mining product, for developmental work, and for diamond and other types of drilling. The Department has available for hire, percussion and diamond drills for exploration, as well as a complete plant for small shaft sinking and tunnelling. Other assistance is rendered to the industry in the form of geological and engineering advice, through ore-dressing research into metallurgical recoveries, and the selection and design of treatment plant.

Northern Territory. To encourage the development of the mining industry the Department of the Northern Territory operates two batteries for the treatment of ores for miners. The Tennant Creek battery will continue cyaniding the gold in accumulated tailings and is available for crushing. The Mount Wells battery is crushing mainly parcels of tin ores. Small quantities of ore containing gold, silver, lead, copper and wolfram are also crushed from time to time. The crushing charges are subsidised by the Government. In addition the Department of the Northern Territory provides cartage subsidies and financial advances to encourage miners to carry out mining operations. Assistance is also given to the mining industry by drilling encouraging prospects. Roads and water supply services are provided and maintained for mines under active development throughout the Northern Territory.

Research

Research investigations into problems of mining, ore-search, ore-dressing and metallurgy are conducted by Government bodies, by universities, by private enterprise, and by combined efforts of these bodies. A summary of their functions follows. (For further information on research see Chapter 28 Science and Technology).

Australian Atomic Energy Commission

The Australian Atomic Energy Commission conducts research at its laboratories at Lucas Heights in Sydney on the development of nuclear power, including research on nuclear materials and on metals and ceramics used for nuclear power.

The Australian Mineral Development Laboratories

Contract research and technical consulting for the mineral and associated industries is undertaken by The Australian Mineral Development Laboratories (Amdel), at Adelaide. This organisation is controlled by a council comprising representatives of the mineral industry, the South Australian Government and the Australian Government. Extensive facilities are available in the fields of analytical chemistry, mineralogy and petrology, chemical metallurgy and mineral engineering, operations research/computer services and materials technology. Both long and short term applied research is carried out and all investigations are conducted on a strictly confidential basis. Services in the field of pollution and environmental control are also available through the Amdel group Amdel (Aspect).

The Baas Becking Geobiological Research Laboratory

In 1965 the Baas Becking Geobiological Research Laboratory was established in the Bureau of Mineral Resources Building in Canberra, under the joint sponsorship of the Commonwealth Scientific and Industrial Research Organization, the Bureau of Mineral Resources, and the Australian Mineral Industries Research Association (*see* Research by private enterprise, page 946). The broad objective of the research work is to investigate the biological and chemical processes associated with the formation of mineral deposits of the stratiform type.

Emphasis is placed on investigations to establish the relationship of biological factors to the natural physico-chemical environment with particular reference to the possible role of these factors in the formation and transformation of sulphide minerals. Investigations have included the response of micro-organisms to heavy metals; biochemistry and physiology of oxidative and reductive sulphur transformations; role of organisms in the concentration of mineral elements; physico-chemistry of low-temperature mineral synthesis; and mobility of sulphides under the influence of temperature and pressure and the interaction of mineral types.

Bureau of Mineral Resources, Geology and Geophysics

The Bureau of Mineral Resources is the largest geoscience research organisation in Australia. Its work is directed towards an integrated study of the origin, composition and structure of the rocks forming the Australian continent—to the lower limits of the continental slope—particularly as these affect the genesis and distribution of mineral deposits. The main effort is in field research supported and complemented by laboratory and office studies. BMR's activities include:

- Geological, geophysical, and geochemical surveys to provide the basic information for further studies.

- Compilation, review, and synthesis of information on and detailed investigations of sedimentary basins and metallogenic provinces, leading to an understanding of their origin and history, and to assessment of their prospectiveness.

- Studies of specific commodities, including research into the occurrence and origin of their deposits, assessment of potential for new discoveries, resource inventories, and market trends.

- Engineering geology, urban geology and hydrogeological investigations.

- Maintenance of seismological and magnetic observatories, and related studies.

- Assessment of geophysical techniques in Australian conditions, and development of new techniques and equipment.

- Fundamental geoscience research, with an orientation to the activities listed above.

- Provision and dissemination of the results of BMR's work and information on the geosciences generally.

For details of the functions of the Bureau of Mineral Resources, Geology and Geophysics, *see* page 943.

Commonwealth Scientific and Industrial Research Organization

Mineral research by the Commonwealth Scientific and Industrial Research Organization is undertaken mainly in the Minerals Research Laboratories comprising the Divisions of Mineral Chemistry, Chemical Engineering, Mineralogy, and Mineral Physics. Major laboratories are located at Clayton (Vic.), Port Melbourne, Sydney and Perth. Current research program objectives and sub-program titles are:

- (a) *Exploration methods.* To improve and develop procedures for locating mineral deposits (geochemical techniques, geophysical techniques, geological pattern recognition).

- (b) *Mineralisation.* To improve methods of recognising and defining the nature and economic significance of specific types of mineralisation (coal and petroleum, nickel deposits, other deposits, hydrogeochemistry, ore-forming fluids, geobiology, mineralogical techniques).
- (c) *Mining and concentration.* To identify, and utilise in practice, those properties of minerals and rocks that will increase the overall efficiency of their mining, concentration and handling (rock properties, mineral dressing, transport and fill, iron ores).
- (d) *Process metallurgy and engineering.* To initiate or improve methods for the scientific development of Australia's natural resources (new products and processes, process control, process improvement and evaluation, structures and bonding, hydrometallurgy).
- (e) *Environment.* To protect and improve the quality of the human and natural environment by applying the skills and expertise available in the Minerals Research Laboratories (air pollution, solid and liquid wastes, treatment of mineral sulphides, reactive carbons).

The minerals industry provides strong support in the form of co-operative research planning, collaborative investigation of specific projects, and financial grants for appropriate developmental work.

National Coal Research Advisory Committee

The National Coal Research Advisory Committee was established in December 1964, following agreement between the Australian Government, State Governments and private industry, for increased applied research in Australia into coal utilisation. This was later extended to cover research into coal winning and beneficiation. Initially a pool of funds amounting to \$520,000 per annum was jointly contributed for the sponsorship of this research. These funds were allocated on the advice of the Committee, whose membership was representative of the contributing groups. This agreement was terminated on 30 June 1969, and a new National Coal Research Advisory Committee was nominated by the Australian Government alone. A sum of up to \$260,000 per year for up to three years was set aside by the Government for allocation on the advice of this Committee.

As from 30 June 1972, the scheme of assistance to coal research was extended for a further five years, with yearly allocations of \$260,000. The major beneficiary under this scheme is the Australian Coal Industry Research Laboratories; other beneficiaries are University Departments.

The functions of the Committee are:

- (a) To keep under review all coal research carried on throughout Australia and overseas, in relation to conservation, winning, beneficiation and utilisation.
- (b) To reach conclusions on scientific, technical and economic grounds as to the directions in which this research in Australia should be strengthened.
- (c) To review annually all relevant research programs in Australia, and to recommend to the Minister for Minerals and Energy those programs that should be supported, and the amount of financial contributions which should be made to each of them from the funds provided.

University Research

The various universities in Australia carry out research into various aspects of the mineral industry such as geology, ore mineralogy and genesis, mining techniques, mineral processing, extractive metallurgy, and materials and metals technology.

Research by private enterprise

Most large mining and smelting companies have laboratories dealing with their own individual problems. Private industry formed the Australian Mineral Industries Research Association in 1959 to provide industry with representation in the management of the Australian Mineral Development Laboratories. The Association now finances research work into geology, mining and mineral processing at Universities, C.S.I.R.O. and the Australian Mineral Development Laboratories. Membership of the Association at 30 June 1973 was: full members 54, associate members 22, registered divisions 12. Expenditure on research projects during the year 1972-73 was \$294,442.

International relations

Because Australia is a large supplier of certain minerals to the rest of the world and because the welfare of the domestic industry depends to a large extent on the maintenance of a high level of exports, international relations are of considerable importance to the industry, and the Australian Government takes an active role in international consultations and discussions relating to minerals. The most important international commitments are discussed below.

International Tin Agreement

The first International Tin Agreement (of the post-war period) was in operation for five years from 1 July 1956 to 30 June 1961. This Agreement was subsequently replaced by the Second and Third International Tin Agreements, which came into force on 21 February 1962 and 21 March 1967, respectively. Details of these Agreements are given in Year Book No. 57, pages 911-12.

Australia has signed and ratified the Fourth International Tin Agreement which came into operation on 1 July 1971 for a period of 5 years. Australia joined the Fourth Agreement as a 'producing' (i.e. exporting) member, whereas in the past Agreements Australia's status had been that of a 'consuming' (i.e. importing) member. This stems from the fact that Australia's tin production has increased significantly over recent years making it a net exporter of tin.

The objectives of this Agreement are the same as for its predecessors. Producing countries are required to contribute to a buffer-stock-equivalent in cash or tin up to 20,000 tonnes of tin metal, which is used to buffer short-term fluctuations in the world market price. In the event of persistent market disequilibrium through causes beyond the ability of the buffer stock mechanism to control, the agreement also provides for the regulation of exports and stocks to stabilise the market. The main provisions of the Fourth Agreement are substantially the same as those of the Third. However, the Buffer Stock Manager, a paid Council employee charged with operating the buffer stock, has been given somewhat greater flexibility in reacting to market situations.

The International Tin Agreement is operated by the International Tin Council, which is made up of the following Governments: *Producers*—Australia, Bolivia, Indonesia, Malaysia, Nigeria (Federal Republic of), Thailand, Zaire (Republic of). *Consumers*—Austria, Belgium-Luxembourg, Bulgaria, Canada, Czechoslovakia, Denmark, France, Germany (Federal Republic of), Hungary, India, Italy, Japan, Korea (Republic of), Netherlands, Poland, Romania, Spain, Turkey, United Kingdom, Union of Soviet Socialist Republics and Yugoslavia. The producing countries hold a total of 1,000 votes, distributed so that each country receives five initial votes and an additional number corresponding to its percentage as laid down by the Agreement. The consuming countries hold a total of 1,000 votes also distributed so that each country receives five initial votes and an additional number proportionate to quantities consumed. The allocation of votes in each category is periodically reviewed.

The International Tin Agreement establishes floor and ceiling prices for tin and, by the medium of a buffer stock and remedial trading on the London Metal Exchange, aims at confining the price within these limits. Because of a world over-supply situation of tin, the Council imposed export controls on producer members for the period January-September 1973.

International Lead-Zinc Study Group

With the cessation of stockpile buying of lead and zinc by the United States Government in 1958, world producers were faced with the prospect of a serious imbalance between world supply and demand for these metals. To meet this problem a series of meetings of interested governments was held, at which Australia was represented. These meetings culminated in the formation of the International Lead-Zinc Study Group which was established in January 1960. The Study Group comprises the following Governments: Algeria, Australia, Austria, Belgium, Bulgaria, Canada, Czechoslovakia, Denmark, Finland, France, the Federal Republic of Germany, Hungary, India, Italy, Japan, Mexico, Morocco, the Netherlands, Norway, Peru, Poland, the Republic of South Africa, Spain, Sweden, Tunisia, the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Yugoslavia and Zambia. The Group provides opportunities for inter-governmental consultations on international trade in lead and zinc and for studies of the world situation in lead and zinc having regard especially to the desirability of providing continuous accurate information regarding the supply and demand position and its probable development.

MINERAL INDUSTRY STATISTICS

Statistics presented in this chapter refer mainly to the mining industry, mineral production, mineral exploration, and overseas participation in the Australian mining industry. In addition to the mining industry, data relating to mineral processing and treatment and overseas trade are included to give more information about the mining industry and other associated activities in the Australian economy.

Mining industry statistics

This section contains statistics of the mining industry for all States and Territories and Australia obtained from the annual Mining Censuses.

Prior to 1968-69 the Annual Mining and Quarrying Census related to years ended 31 December. However, commencing with 1968-69, the Mining Census was changed to a year ended 30 June to conform with the period covered by other economic censuses in Australia. There are several other differences between the censuses of 1968-69 and later years, and those for earlier years (mainly in definition, scope and coverage) and as a result the statistics obtained for 1968-69 and later, are not strictly comparable with those for earlier years. Further information regarding these differences is given in Year Book No. 57, pages 912-914. Mining industry statistics for years prior to 1968-69 are also contained in Year Book No. 57 and earlier issues.

For the year ended June 1969, the Mining Census (including quarrying) was conducted for the first time on an integrated basis with Censuses of Manufacturing, Electricity and Gas, Retail Trade and Selected Services, and Wholesale Trade.

Briefly, the integration of these economic censuses was designed to increase substantially the usefulness and comparability of economic statistics collected and published by the Bureau, and to form a basis for the sample surveys which supply current economic statistics from quarter to quarter, particularly those which provide data for the quarterly national income and expenditure estimates. A detailed description of the integrated censuses is contained in Chapter 31, Year Book No. 56.

For 1969-70 and subsequent years the annual Mining Census has been conducted on the same basis as that for 1968-69.

The table below shows key items of data for Australia for 1972-73 and summary data for 1968-69 to 1971-72. Each following table shows statistics for a particular item for all States and Territories and Australia for 1972-73 and summary data for 1968-69 to 1971-72, and is preceded by an explanation of the item.

MINING ESTABLISHMENTS: SUMMARY OF OPERATIONS BY INDUSTRY SUB-DIVISION AUSTRALIA

Industry sub-division	ASIC code(a)	Number of estab- lish- ments operat- ing at end of June	Persons employed at end of June(b)			Wages and salaries	Turn- over	Stocks at 30 June		Pur- chases, transfers in and selected expenses	Value added	Fixed capital expendi- ture (outlay on fixed tangible assets less dis- posals)
								Opening	Closing			
			Males	Females	Total							
		No.	No.	No.	No.	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
1972-73—												
Metallic minerals . . .	11	224	29,787	1,855	31,642	200,805	1,175,452	131,793	125,892	353,096	816,454	174,567
Coal . . .	12	129	21,940	487	22,427	155,954	855,069	57,039	62,505	222,995	637,539	118,791
Crude petroleum includ- ing natural gas . . .	13	9										
Construction materials . .	14	707	5,879	411	6,290	32,242	169,505	15,289	14,782	62,262	106,735	10,834
Other non-metallic minerals . . .	15	261	2,581	167	2,748	14,185	61,467	6,830	8,596	29,012	34,222	18,737
Total mining, excluding services to mining—												
1972-73 . . .		1,330	60,187	2,920	63,107	403,186	2,261,493	210,951	211,775	667,365	1,594,951	322,930
1971-72 . . .		1,426	60,222	2,957	63,179	373,999	1,994,261	165,244	211,373	611,888	1,428,502	482,611
1970-71 . . .		1,566	59,816	2,826	62,642	325,178	1,814,918	142,298	157,365	540,493	1,289,492	520,575
1969-70 . . .		1,502	56,468	2,382	58,850	275,620	1,479,785	114,960	138,354	460,594	1,042,587	348,255
1968-69 . . .		1,493	53,353	2,089	55,442	241,292	1,147,881	97,771	113,367	414,277	749,201	303,537

(a) Australian Standard Industrial Classification.

(b) Includes working proprietors.

Number of establishments

The following table shows the number of establishments operating at end of June. These relate to mining establishments as such and do not include the numbers of separately located administrative offices and ancillary units.

MINING ESTABLISHMENTS: NUMBER OF ESTABLISHMENTS OPERATING AT END OF JUNE BY INDUSTRY SUB-DIVISION

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
1972-73—										
Metallic minerals . . .	11	86	6	35	4	67	16	10	..	224
Coal . . .	12	95	5	24	1	3	1	..	..	129
Crude petroleum including natural gas . . .	13	..	2	4	1	2	..	..	..	9
Construction materials . . .	14	223	212	149	60	28	21	5	9	707
Other non-metallic minerals . . .	15	128	36	28	28	31	10	..	..	261
Total mining, excluding services to mining—										
1973 . . .		532	261	240	94	131	48	15	9	1,330
1972 . . .		588	264	266	104	115	53	26	10	1,426
1971 . . .		668	266	292	122	122	64	24	8	1,566
1970 . . .		620	221	300	130	122	78	25	6	1,502
1969 . . .		581	248	299	135	128	75	20	7	1,493

(a) Australian Standard Industrial Classification.

Employment

The statistics of the number of persons employed shown in the following table relate to working proprietors at the end of June and employees on the payroll of the last pay period in June, including those working at separately located administrative offices and ancillary units in the State. Note that persons employed in each State (and their wages and salaries) relate to those employed at establishments, administrative offices or ancillary units located in the State, even though the administrative offices or ancillary units may have served establishments located in another State.

**MINING ESTABLISHMENTS: MALES, FEMALES AND PERSONS EMPLOYED(a)
BY INDUSTRY SUB-DIVISION, AT END OF JUNE 1973**

Industry sub-division	ASIC code(b)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
MALES EMPLOYED										
1972-73—										
Metallic minerals . . .	11	6,414	3,166	7,392	1,503	9,423	3,913	1,352	..	29,787
Coal . . .	12	13,749		4,042		709	(c)	..	..	21,940
Crude petroleum including natural gas . . .	13	..	1,729	(c)	526	484	142	..	76	5,819
Construction materials . . .	14	1,654		1,211						
Other non-metallic minerals . . .	15	1,026	237	(c)	325	652	(c)	57	..	2,578
Total mining, excluding services to mining—										
1973 . . .		22,843	5,132	12,955	2,354	11,268	4,150	1,409	76	60,187
1972 . . .		24,192	5,560	12,308	2,293	9,816	4,449	1,513	91	60,222
1971 . . .		24,640	5,189	11,859	1,866	10,285	4,463	1,427	87	59,816
1970 . . .		24,135	5,261	10,701	1,924	8,857	4,139	1,361	90	56,468
1969 . . .		23,064	5,092	9,889	1,868	8,189	3,932	1,233	86	53,353

FEMALES EMPLOYED

1972-73—										
Metallic minerals . . .	11	213	212	538	160	663	174	59	..	1,855
Coal . . .	12	203		101		16	(c)	..	..	487
Crude petroleum including natural gas . . .	13	..	170	(c)	24	52	..	..	1	411
Construction materials . . .	14	77		80						
Other non-metallic minerals . . .	15	83	12	(c)	12	49	(c)	5	..	167
Total mining, excluding services to mining—										
1973 . . .		576	394	733	196	780	176	64	1	2,920
1972 . . .		662	455	735	218	621	191	74	1	2,957
1971 . . .		642	394	690	128	704	197	68	3	2,826
1970 . . .		660	326	635	122	408	173	56	2	2,382
1969 . . .		564	325	558	96	343	145	48	10	2,089

PERSONS EMPLOYED

1972-73—										
Metallic minerals . . .	11	6,627	3,378	7,930	1,663	10,086	4,087	1,411	..	31,642
Coal . . .	12	13,952		4,143		725	(c)	..	..	22,427
Crude petroleum including natural gas . . .	13	..	1,899	(c)	550	536	144	..	77	6,290
Construction materials . . .	14	1,731		1,291						
Other non-metallic minerals . . .	15	1,109	249	(c)	337	701	(c)	62	..	2,748
Total mining, excluding services to mining—										
1973 . . .		23,419	5,526	13,688	2,550	12,048	4,326	1,473	77	63,107
1972 . . .		24,854	6,015	13,043	2,511	10,437	4,640	1,587	92	63,179
1971 . . .		25,282	5,583	12,549	1,994	10,989	4,660	1,495	90	62,642
1970 . . .		24,795	5,587	11,336	2,046	9,265	4,312	1,417	92	58,850
1969 . . .		23,628	5,417	10,447	1,964	8,532	4,077	1,281	96	55,442

(a) At end of June; includes working proprietors.
available for publication.

(b) Australian Standard Industrial Classification.

(c) Not

Mining accidents

Particulars of persons killed and injured in accidents in mines and associated treatment plants are recorded by State Mines Departments. Numbers injured are not reported on a uniform basis in all States, as varying criteria are used in determining what constitutes injury. A table setting out mining accidents by States is shown below.

MINING ACCIDENTS(a)

	Metal mining		Fuel mining		Construction material quarrying(b)		Non-metal (excluding fuel) mining		Total mining and quarrying	
	Number of casualties		Number of casualties		Number of casualties		Number of casualties		Number of casualties	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
1972-73—										
New South Wales	4	64	13	43	..	10	1	20	18	137
Victoria . . . . .	..	1	..	34	1	(c)61	..	(c)10	1	(c)106
Queensland	3	184	2	196	..	9	..	7	5	396
South Australia . . . . .	..	18	1	4	2	39	2	3	5	64
Western Australia	(c)8	(c)332	..	66	..	12	..	6	(c)8	(c)416
Tasmania	3	145	..	..	..	10	..	..	3	155
Northern Territory	2	28	..	4	..	..	..	..	2	32
Australian Capital Territory . . . . .	..	..	..	..	(b)	(b)	..	..	(b)	(b)
Australia(b)(c)	20	772	16	347	3	141	3	46	42	1,306
1971-72(b)	29	685	41	425	4	118	1	33	75	1,261

(a) See text regarding comparability between States. (b) Mining accident data for construction material quarrying in the A.C.T. are not available. (c) These figures include some accidents in the mineral processing industry, and, in Western Australia, in electricity generating plants at the mine site.

Wages and salaries

The following table shows the wages and salaries of all employees of the establishment, including those working at separately located administrative offices and ancillary units in the State. Drawings of working proprietors are not included.

MINING ESTABLISHMENTS: WAGES AND SALARIES BY INDUSTRY SUB-DIVISION (\$'000)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
1972-73—										
Metallic minerals	11	39,091	22,561	{ 55,119 32,058 }	8,962	{ 60,451 4,346 }	{ 26,955 (b) }	10,400	..	200,805
Coal	12	96,412								
Crude petroleum including natural gas	13	..	9,514	{ (b) 6,021 }	2,627	{ 3,053 647 }	{ .. (b) }	..	503	155,954
Construction materials	14	9,433								
Other non-metallic minerals	15	5,014	1,079	(b)	1,778	4,388	(b)	443	..	14,185
Total mining, excluding services to mining—										
1972-73		149,950	33,154	95,039	13,367	72,238	28,091	10,843	503	403,186
1971-72		147,098	32,194	83,087	12,255	62,388	26,458	10,066	453	373,999
1970-71		132,236	27,518	69,211	8,459	55,941	22,641	8,702	471	325,178
1969-70		120,079	23,671	55,430	7,360	42,603	18,544	7,478	455	275,620
1968-69		108,287	22,840	48,181	6,929	30,851	17,217	6,626	360	241,292

(a) Australian Standard Industrial Classification. (b) Not available for publication.

Turnover

The following table shows turnover (sales of minerals and other goods whether produced by the establishment or not, plus transfers out of minerals and other goods to other establishments of the same enterprise, plus all other operating revenue from outside the enterprise, such as commission, repair and service revenue). This item excludes rents, leasing revenue, interest, royalties, and receipts from the sale of fixed tangible assets.

MINING ESTABLISHMENTS: TURNOVER, BY INDUSTRY SUB-DIVISION
(\$'000)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
1972-73—										
Metallic minerals . . .	11	146,229	314,415	228,268	83,249	583,343	90,605	60,531	..	1,175,452
Coal . . .	12	279,189		195,404		45,602	(b)	..	..	855,069
Crude petroleum including natural gas . . .	13	..	..	(b)	..		..	..	..
Construction materials . .	14	52,640	56,654	27,728	13,067	11,618	3,407	..	2,547	169,505
Other non-metallic minerals . . .	15	21,128	6,714	(b)	12,292	12,486	(b)	1,843	..	61,467
Total mining, excluding services to mining—										
1972-73 . . .	..	499,187	377,783	462,594	108,608	653,049	95,350	62,374	2,547	2,261,493
1971-72 . . .	..	483,654	336,464	345,568	96,034	593,944	88,675	47,747	2,176	1,994,261
1970-71 . . .	..	475,180	270,659	323,536	96,856	527,107	78,057	41,336	2,187	1,814,918
1969-70 . . .	..	443,443	118,098	299,956	90,595	403,164	84,141	38,411	1,978	1,479,785
1968-69 . . .	..	371,184	92,730	228,590	81,184	273,186	63,073	36,292	1,641	1,147,881

(a) Australian Standard Industrial Classification. (b) Not available for publication.

Purchases, transfers in and selected expenses

The following table shows the total of purchases of electricity, fuels, stores and other materials, transfers in of goods from other establishments of the same enterprise, charges for processing and other commission work and payments to mining contractors, repair and maintenance expenses, outward freight and cartage, motor vehicle running expenses and sales commission payments.

MINING ESTABLISHMENTS: PURCHASES, TRANSFERS IN AND SELECTED EXPENSES
BY INDUSTRY SUB-DIVISION,
(\$'000)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
1972-73—										
Metallic minerals . . .	11	51,192	33,523	52,062	25,604	185,295	29,622	16,200	..	353,096
Coal . . .	12	101,552		76,167		4,523	(b)	..	..	222,995
Crude petroleum including natural gas . . .	13	..	..	(b)	..		..	..	..
Construction materials . .	14	16,848	23,611	9,382	3,985	5,133	1,681	..	907	62,262
Other non-metallic minerals . . .	15	10,621	3,531	(b)	6,453	4,222	(b)	715	..	29,012
Total mining, excluding services to mining—										
1972-73 . . .	..	180,214	60,666	141,686	36,041	199,171	31,765	16,915	907	667,365
1971-72 . . .	..	181,356	53,953	117,519	33,922	179,725	29,948	14,669	796	611,888
1970-71 . . .	..	183,804	52,470	83,101	31,894	146,904	21,408	19,989	921	540,493
1969-70 . . .	..	158,636	38,016	73,311	30,770	125,147	20,796	13,207	711	460,594
1968-69 . . .	..	147,166	38,469	75,913	26,242	90,867	20,128	14,827	665	414,277

(a) Australian Standard Industrial Classification. (b) Not available for publication.

Stocks

Statistics on the value of closing stocks are shown in the following table. Figures include stocks of materials, fuels, etc., and mine products and work-in-progress of the establishment whether located at the establishment or elsewhere.

**MINING ESTABLISHMENTS: CLOSING STOCKS AT END OF JUNE BY INDUSTRY
SUB-DIVISION**
(\$'000)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
CLOSING STOCKS										
1973—										
Metallic minerals . . .	11	34,644	11,948	16,599	6,937	50,392	12,511	7,596	..	125,892
Coal . . .	12	26,184		19,175		2,265	(b)	..	..	62,505
Crude petroleum includ- ing natural gas . . .	13	..	..	(b)	..		..	..	..
Construction materials . .	14	7,325	3,194	1,818	730	883	355	..	226	14,782
Other non-metallic minerals . . .	15	1,820	746	(b)	1,519	3,922	(b)	251	..	8,596
Total mining, excluding services to mining—										
1973 . . .	..	69,973	15,888	38,261	9,186	57,461	12,933	7,847	226	211,775
1972 . . .	..	64,639	16,003	38,567	8,156	60,489	14,391	8,897	230	211,373
1971 . . .	..	46,084	13,268	28,357	5,649	45,225	12,502	6,114	167	157,365
1970 . . .	..	42,815	12,258	22,861	4,467	39,093	11,464	5,198	197	138,354
1969 . . .	..	37,347	9,713	19,733	3,607	28,343	9,450	5,097	78	113,367

(a) Australian Standard Industrial Classification. (b) Not available for publication.

Value added

The following table shows value added, calculated as the value of turnover (sales plus transfers out and other operating revenue) and closing stocks *less* purchases plus transfers in and selected expenses and opening stocks.

MINING ESTABLISHMENTS: VALUE ADDED, BY INDUSTRY SUB-DIVISION
(\$'000)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
1972-73—										
Metallic minerals	11	97,151	280,158	173,859 122,734	59,072	393,776 41,766	59,553 (b)	44,011 ..	..	816,454
Coal	12	178,506								
Crude petroleum including natural gas	13	35,279	33,250	18,319 (b)	9,052	6,499	1,740	..	1,644	637,539
Construction materials	14	35,279								
Other non-metallic minerals	15	11,356	3,211	(b)	5,697	9,283	(b)	951	..	106,735
Total mining, excluding services to mining—										
1972-73		322,291	316,619	322,103	73,822	451,324	62,186	44,962	1,644	1,594,951
1971-72		320,546	283,445	239,208	64,707	424,008	59,317	35,826	1,444	1,428,502
1970-71		292,194	217,953	245,746	65,665	386,444	58,095	22,161	1,236	1,289,492
1969-70		290,232	82,478	229,970	60,120	286,874	65,791	25,735	1,386	1,042,587
1968-69		227,752	51,628	155,788	55,473	191,098	44,286	22,200	976	749,201

(a) Australian Standard Industrial Classification. (b) Not available for publication.

Fixed capital expenditure

Figures in the following table relate to fixed capital expenditure. Such figures are calculated by deducting disposals of fixed tangible assets from the total outlay on new and second-hand tangible assets.

MINING ESTABLISHMENTS: FIXED CAPITAL EXPENDITURE (OUTLAY ON FIXED TANGIBLE ASSETS LESS DISPOSALS) BY INDUSTRY SUB-DIVISION
(\$'000)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
1972-73—										
Metallic minerals	11	10,685	22,327	60,915 62,076	14,566	76,299 1441	12,107 (b)	10,229 ..	..	174,567
Coal	12	22,339								
Crude petroleum including natural gas	13	5,088	2,225	1,660 (b)	860	642	170 (b)	..	77	11,8791
Construction materials	14	5,088								
Other non-metallic minerals	15	3,454	1,369	(b)	636	9,402	(b)	111	..	10,834
Total mining, excluding services to mining—										
1972-73		41,566	25,920	128,696	16,062	87,785	12,482	10,341	77	322,930
1971-72		76,963	32,335	155,810	12,082	167,174	16,532	21,672	44	482,611
1970-71		77,008	80,389	103,454	14,665	186,643	25,967	31,837	610	520,575
1969-70		60,885	93,393	54,295	12,311	92,904	20,597	13,655	216	348,255
1968-69		44,857	103,816	38,808	7,786	84,692	12,910	10,618	51	303,537

(a) Australian Standard Industrial Classification. (b) Not available for publication.

Mineral production

This section contains details of the output (quantities and values) of minerals during the year ended June 1973 for all States and Territories and Australia, together with information for Australia for the four preceding years.

Minerals are classified into five major groups, namely metallic minerals, coal, crude petroleum (including natural gas), construction materials and other non-metallic minerals. In the statistics published in this section the minerals are arranged in these five groups.

Mineral production statistics are derived from data collected in the annual mining census (which since 1968-69 has been collected on a June year basis), and in returns to the various State Mines Departments, supplemented in some cases by information made available by the Department of Minerals and Energy and by data compiled by the Bureau of Statistics from other sources.

Scope of mineral statistics and relation to mining industry statistics

The statistics of mineral production for the years ended June 1969 and later years apart from the change to a June year basis, are comparable with those for earlier years. Although the integration of the mining census for 1968-69 with other economic censuses conducted in that year (manufacturing, electricity and gas, retail trade, and wholesale trade) was accompanied by major changes in the scope of the mining census and thus in the scope of the mining industry statistics, these changes had little effect on the scope of the mineral production statistics now published. This is because mineral

production data were collected, not only from establishments coming within the scope of the mining census as now defined, but also from those establishments classified as non-mining establishments which, as a subsidiary activity, carried out mining or quarrying activities (e.g. brick and cement manufacturing establishments extracting clays, limestone), and from itinerant and part-time miners.

However, as in past years, coverage is deficient in the case of some minerals, principally because of the difficulties in obtaining complete lists of producers and collecting satisfactory returns.

Principles for measuring output of minerals

The quantities of individual minerals produced are recorded, in general, in the form in which the minerals are dispatched from the mine or from associated treatment works in the locality of the mine. Thus, for metallic minerals, the output is recorded as ore if no treatment is undertaken at or near the mine, and as concentrate if ore dressing operations are carried out in associated works in the locality of the mine. In addition to the basic quantity data, the content of metallic minerals (based on assay) are recorded. No allowance has been made for losses in smelting and refining and the quantities shown are therefore, in general, greater than the contents actually recoverable.

The output of individual minerals is valued at the mine or at associated treatment works in the locality of the mine. This valuation is derived, in general, by valuing the quantity produced during the year at the unit selling value (including any subsidy) less any transport costs from the mine or associated treatment works to the point of sale. For some metals, however, special values of output, based on actual or estimated realisations are supplied by certain large mineral producers.

It should be noted that, commencing with the year 1968-69, the output of metals by enterprises for their own consumption in Australia has been valued on a different basis to that used in previous years. The effect of these changes is that the overall value of coal produced in 1968-69 and later years is somewhat lower and the value of certain other minerals somewhat higher than if the earlier valuation methods had been retained.

Quantity of minerals produced

The following tables show particulars of the quantities of minerals produced during 1972-73 and earlier years *together with details of the aggregate quantity of each metal, metallic oxide or elements contained in the various metallic minerals produced.*

QUANTITY OF MINERALS PRODUCED AND METALLIC CONTENTS OF ORES
CONCENTRATES ETC 1972-73

Mineral		N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
METALLIC MINERALS										
Antimony concentrate	tonnes	1,440	..	..	..	..	..	..	..	1,440
Antimony content	"	930	..	..	..	..	..	..	..	930
Antimony ore	tonnes	..	(a)	..	..	..	..	..	..	(a)
Antimony content	"	..	(a)	..	..	..	..	..	..	(a)
Bauxite	'000 tonnes	10	4	7,773	..	5,500	..	1,415	..	14,702
Alumina (Al ₂ O ₃) content	"	4	2	(a)	..	(a)	..	(a)	..	(a)
Beryllium ore	tonnes	..	..	..	..	118	..	..	..	118
Beryllium oxide (Be O) content	m.t.u.	..	..	..	..	1,386	..	..	..	1,386
Bismuth concentrate	tonnes	..	..	..	..	..	..	1,609	..	1,609
Bismuth content	kg	..	..	..	..	..	..	343,349	..	343,349
Copper content	tonnes	..	..	..	..	..	..	157	..	157
Gold content	'000 grams	..	..	..	..	..	..	2,026	..	2,026
Selenium content	tonnes	..	..	..	..	..	..	31	..	31
Silver content	'000 grams	..	..	..	..	..	..	520	..	520
Copper concentrate	tonnes	47,065	..	612,469	38,415	465	91,514	34,844	..	824,772
Copper content	"	11,481	..	134,083	8,881	139	23,449	8,730	..	186,763
Bismuth content	kg	..	..	..	..	..	..	12,100	..	12,100
Gold content	'000 grams	..	..	1,405	99	(b)	475	484	..	2,463
Lead content	tonnes	633	..	..	..	..	..	..	..	633
Silver content	'000 grams	8,023	..	20,387	1,625	(c)	3,965	4,343	..	38,343
Zinc content	tonnes	2,058	..	..	..	..	..	..	..	2,058
Copper ore	tonnes	728	..	11,631	..	..	..	145	..	12,504
Copper content	"	66	..	864	..	..	..	16	..	946
Gold content	'000 grams	1	..	..	..	..	..	..	..	1
Copper ore for fertilizer	tonnes	..	..	..	3,048	..	..	..	..	3,048
Copper content	"	..	..	..	24	..	..	..	..	24
Copper oxide	tonnes	..	..	..	976	..	..	..	..	976
Copper content	"	..	..	..	752	..	..	..	..	752
Copper precipitate	tonnes	154	..	6	6	..	..	4	..	170
Copper content	"	119	..	5	4	..	..	2	..	130
Gold bullion(d)	'000 grams	25	148	983	..	12,494	..	4,280	..	17,930
Gold content	"	20	141	337	..	(e)9,264	..	4,176	..	13,938
Silver content	"	1	..	646	..	(f)2,616	..	1	..	3,264
Iron ore	'000 tonnes	..	..	..	6,874	64,434	(g)2,451	885	..	74,645
Iron content	"	..	..	..	4,307	40,693	1,696	508	..	47,204
Iron oxide(h)	tonnes	35,691	596	40,692	..	..	9,590	..	..	86,569

For footnotes see end of table.

**QUANTITY OF MINERALS PRODUCED: AND METALLIC CONTENTS OF ORES
CONCENTRATES ETC., 1972-73—continued**

<i>Mineral</i>		<i>N.S.W.</i>	<i>Vic.</i>	<i>Qld</i>	<i>S.A.</i>	<i>W.A.</i>	<i>Tas.</i>	<i>N.T.</i>	<i>A.C.T.</i>	<i>Aust.</i>
Lead concentrate . . .	tonnes	315,885	..	243,456	..	(i) 22,837	..	..	..	(j) 582,178
Lead content . . .	"	226,800	..	116,481	..	(k) 13,414	..	..	..	356,695
Antimony content . . .	"	619	..	..	..	..	..	..	..	619
Cadmium content . . .	"	48	..	5	..	..	..	..	..	53
Copper content . . .	"	2,767	..	331	..	..	78	..	..	3,176
Gold content . . .	'000 grams	221	..	..	..	..	91	..	..	312
Silver content . . .	"	230,367	..	243,463	..	..	16,785	..	..	490,615
Sulphur content . . .	tonnes	46,261	..	..	..	..	4,565	..	..	50,826
Zinc content . . .	"	12,301	..	15,709	..	(l) 3,776	..	..	..	31,786
Lead-copper concentrate . . .	tonnes	..	..	..	..	..	16,605	..	..	16,605
Lead content . . .	"	..	..	..	..	..	5,034	..	..	5,034
Copper content . . .	"	..	..	..	..	..	1,828	..	..	1,828
Gold content . . .	'000 grams	..	..	..	..	..	1,038	..	..	1,038
Silver content . . .	"	..	..	..	..	..	49,357	..	..	49,357
Sulphur content . . .	tonnes	..	..	..	..	..	4,427	..	..	4,420
Zinc content . . .	"	..	..	..	..	..	2,333	..	..	2,333
Lead ore(m) . . .	tonnes	3,471	..	36,278	11	..	..	..	..	39,767
Lead content . . .	"	535	..	1,996	(n) 22	..	..	..	..	2,553
Copper content . . .	"	4	..	..	..	..	..	..	..	4
Silver content . . .	'000 grams	1,087	..	2,388	5	..	..	..	..	3,480
Zinc content . . .	tonnes	63	..	..	..	..	..	..	..	63
Lead zinc middlings . . .	tonnes	26,553	..	..	..	..	..	..	..	26,553
Lead content . . .	"	5,733	..	..	..	..	..	..	..	5,733
Antimony content . . .	"	34	..	..	..	..	..	..	..	34
Cadmium content . . .	"	29	..	..	..	..	..	..	..	29
Copper content . . .	"	175	..	..	..	..	..	..	..	175
Gold content . . .	'000 grams	23	..	..	..	..	..	..	..	23
Silver content . . .	"	23,880	..	..	..	..	..	..	..	23,880
Sulphur content . . .	tonnes	5,515	..	..	..	..	..	..	..	5,515
Zinc content . . .	"	8,038	..	..	..	..	..	..	..	8,038
Manganese ore—										
Metallurgical grade . . .	tonnes	..	..	..	..	30,371	..	1,264,986	..	1,295,357
Manganese content . . .	"	..	..	..	..	14,525	..	609,517	..	624,042
Other grades . . .	tonnes	..	..	16	..	..	..	..	..	16
Manganese content . . .	"	..	..	4	..	..	..	..	..	4
Mineral sands(o)—										
Ilmenite concentrate . . .	tonnes	12,116	..	..	268	p 708,612	..	..	..	720,996
Titanium dioxide content . . .	"	5,452	..	..	134	390,928	..	..	..	396,514
Leucocoxene concentrate . . .	tonnes	..	..	..	..	10,465	..	..	..	10,465
Titanium dioxide content . . .	"	..	..	..	..	9,336	..	..	..	9,336
Monazite concentrate . . .	tonnes	1,971	..	41	..	2,522	..	..	..	4,534
Monazite content . . .	"	1,774	..	26	..	2,348	..	..	..	4,148
Rutile concentrate . . .	tonnes	216,792	..	98,267	894	2,745	..	..	..	318,698
Titanium dioxide content . . .	"	208,119	..	94,336	856	2,651	..	..	..	305,962
Xenotime concentrate . . .	tonnes	..	..	..	..	17	..	..	..	17
Yttrium oxide content . . .	kg	..	..	..	..	4,318	..	..	..	4,318
Zircon concentrate . . .	tonnes	242,499	..	73,666	..	56,859	..	..	..	373,024
Zirconium dioxide content . . .	"	161,403	..	48,805	..	37,337	..	..	..	247,545
Nickel concentrate . . .	tonnes	..	..	..	..	268,349	..	..	..	268,349
Nickel content . . .	"	..	..	..	..	36,104	..	..	..	36,104
Cobalt content . . .	"	..	..	..	..	203	..	..	..	203
Copper content . . .	"	..	..	..	..	2,659	..	..	..	2,659
Nickel ore . . .	tonnes	..	..	..	..	(a)	..	..	..	(a)
Nickel content . . .	"	..	..	..	..	(a)	..	..	..	(a)
Pyrite concentrate . . .	tonnes	..	..	283	..	197,813	..	..	..	198,096
Sulphur content . . .	"	..	..	130	..	93,709	..	..	..	93,839
Tantalite-colombite concentrate . . .	kg	..	..	..	..	236,831	..	..	..	236,831
Tantalite-colombite content . . .	"	..	..	..	..	84,744	..	..	..	84,744
Tin concentrate . . .	tonnes	5,265	10	1,952	..	1,360	13,895	31	..	22,513
Tin content . . .	"	2,998	5	1,342	..	972	6,289	19	..	11,625
Tin-copper concentrate . . .	tonnes	..	..	..	..	..	4,586	..	..	4,586
Tin content . . .	"	..	..	..	..	..	129	..	..	129
Copper content . . .	"	..	..	..	..	..	878	..	..	878
Tungsten concentrates—										
Scheelite concentrate . . .	tonnes	1	..	..	..	..	1,788	..	..	1,789
Tungstic oxide content . . .	m.t.u.	73	..	..	..	..	131,900	..	..	131,973
Wolfram concentrate . . .	tonnes	2	..	117	..	..	642	..	..	761
Tungstic oxide content . . .	m.t.u.	128	..	7,900	..	..	47,500	..	..	55,528
Wolfram ore . . .	tonnes	..	122	..	..	..	..	..	..	122
Tungstic oxide content . . .	m.t.u.	..	100	..	..	..	..	..	..	100
Zinc concentrate . . .	tonnes	543,586	..	196,575	..	..	125,087	..	..	865,248
Zinc content . . .	tonnes	294,357	..	101,816	..	..	66,544	..	..	462,717
Cadmium content . . .	"	989	..	393	..	..	165	..	..	1,547
Cobalt content . . .	"	107	..	..	..	..	..	..	..	107
Copper content . . .	"	708	..	..	..	..	518	..	..	1,226
Gold content . . .	'000 grams	36	..	..	..	..	165	..	..	201
Lead content . . .	tonnes	6,072	..	3,672	..	..	4,616	..	..	14,360
Manganese content . . .	"	5,489	..	..	..	..	2,954	..	..	8,443
Mercury content . . .	kg	..	..	..	..	..	512	..	..	512
Silver content . . .	'000 grams	18,381	..	26,000	..	..	16,642	..	..	61,023
Sulphur content . . .	tonnes	220,992	..	62,904	..	..	41,064	..	..	324,960

For footnotes see end of table.

**QUANTITY OF MINERALS PRODUCED AND METALLIC CONTENTS OF ORES
CONCENTRATES ETC., 1972-73—continued**

<i>Mineral</i>		<i>N.S.W.</i>	<i>Vic.</i>	<i>Qld</i>	<i>S.A.</i>	<i>W.A.</i>	<i>Tas.</i>	<i>N.T.</i>	<i>A.C.T.</i>	<i>Aust.</i>
COAL										
Black coal—	'000 tonnes	38,060	..	18,842	1,571	1,154	128	..	..	59,755
Bituminous	..	38,060	..	18,255	..	..	128	..	..	56,444
Sub-bituminous	..	..	..	587	1,571	1,154	..	..	..	3,311
Brown coal (lignite)(q)	..	..	20,922	..	..	..	..	..	..	20,922
Brown coal briquettes	..	..	1,228	..	..	..	..	..	..	1,228
PETROLEUM(r)										
Crude oil	'000 cu m	..	18,179	117	..	2,373	..	..	..	20,669
Natural gas	mil. cu m	..	1,472	269	1,122	851	..	..	..	3,713
Natural gas condensate(s)	cu m	..	2,648	..	..	6,884	..	..	..	9,532
Ethane(r)	'000 cu m	..	27,436	..	..	..	..	..	..	27,436
Liquefied petroleum gases(r)—										
Propane	'000 cu m	..	798	..	..	..	..	..	..	798
Butane	'000 cu m	..	988	..	..	..	..	..	..	988
CONSTRUCTION MATERIALS(u)										
Sand	'000 tonnes	8,151	6,660	3,838	2,447	n.a.	203	169	402 (v)	21,869
Gravel	..	3,535	3,634	4,094	832	n.a.	1,110	1,178	138 (v)	14,520
Dimension stone	..	19	15	1	45	208	1	..	1	288
Crushed and broken stone	..	11,547	15,805	6,011	10,930	4,364	1,452	334	594	51,037
Other (decomposed rock, etc.)	..	37,208	3,180	364	1,211	..	151	..	..	42,113
OTHER NON-METALLIC MINERALS										
Asbestos	tonnes	32,358	..	..	..	..	..	..	..	32,358
Barite	..	406	..	..	17,842	..	..	4,927	..	23,175
Carbon dioxide	..	..	..	..	(a)	..	..	..	..	(a)
Clays—										
Brick and shale	'000 tonnes	3,227	1,916	894	660	1,257	128	15	..	8,098
Other	..	410	313	162	95	249	91	..	..	1,321
Diatomite	tonnes	1,426	2,279	1,087	..	..	..	..	..	4,792
Dolomite	..	868	..	12,243	385,349	..	3,852	..	..	402,312
Felspar (including cor-nish stone)	..	1,700	..	..	973	243	..	..	..	2,916
Fluorspar	..	..	1,700	..	..	..	..	..	..	1,700
Garnet concentrate	..	111	..	..	..	..	..	..	..	111
Gypsum	..	33,967	43,696	..	743,544	140,510	..	..	..	961,717
Limestone (including shell and coral)	'000 tonnes	3,677	2,163	1,700	1,636	1,225	559	..	..	10,960
Lithium ores(w)	tonnes	..	..	..	..	695	..	..	..	695
Lithia (Li ₂ O) content	m. t. u.	..	..	..	..	2,828	..	..	..	2,828
Magnesite, crude	tonnes	21,308	..	..	514	..	..	..	..	21,822
Mineral pigments—red ochre	..	..	..	..	..	551	74	..	..	625
Peat(x)	..	4,522	..	..	..	(a)	241	..	..	(a)
Pebbles—for grinding	..	..	..	..	375	..	1,134	..	..	1,509
Perlite	..	..	..	1,834	..	..	..	..	..	1,834
Phosphate rock	..	..	..	..	1,494	..	..	..	..	1,494
Pyrophyllite	..	12,718	..	..	..	..	..	..	..	12,718
Salt	'000 tonnes	..	(a)	(a)	591	2,913	..	..	..	3,671
Silica	tonnes	408,068	109,024	528,183	62,132	35,816	25,596	..	..	1,168,819
Sillimanite	..	42	..	..	612	..	..	..	..	654
Talc (including steatite and chlorite)	..	1,340	..	..	11,871	34,716	..	..	..	47,927
Vermiculite	..	..	..	..	..	636	..	..	..	636

(a) Not available for publication. (b) Included with gold content of gold bullion. (c) Included with silver content of gold bullion. (d) Includes alluvial gold. (e) Includes gold content of copper concentrate. (f) Includes silver content of copper concentrate. (g) Iron concentrate. (h) For cement manufacture, coal washing, flux and gas purification. (i) Not available for publication; excluded from total. (j) Excludes Western Australian production. (k) Included with lead content of South Australian lead ore. (l) Not available for publication, omitted from total. (m) Includes silver-lead ore, silver-lead slimes and lead slag. (n) Includes lead content of Western Australian lead concentrate. (o) Details relating to rutile-zircon concentrates produced in one State and finally separated in another State are included in separated form in the data of the State of origin. (p) Includes beneficiated Ilmenite. (q) In addition 3,199,000 tonnes of brown coal valued at \$3,839,000 was used in making briquettes. (r) Source: Department of Minerals and Energy and State Mines Departments. (s) Sales—excludes condensate blended with other petroleum products. (t) Excludes refinery production. (u) Incomplete see individual States. (v) Incomplete, excludes Western Australia. (w) Used mainly for non-metallic purposes. (x) Comprises peat for fertiliser and peat moss.

**QUANTITY OF MINERALS PRODUCED AND METALLIC CONTENTS OF ORES
CONCENTRATES ETC.: AUSTRALIA**

<i>Mineral</i>		1968-69	1969-70	1970-71	1971-72	1972-73
METALLIC MINERALS						
Antimony concentrate	tonnes	265	345	887	611	1,440
Antimony content	"	173	131	424	338	930
Antimony ore	tonnes	..	7	2,934	(a)	(a)
Antimony content	"	..	2	278	(a)	(a)
Bauxite	'000 tonnes	6,317	8,294	11,043	13,697	14,702
Alumina (Al ₂ O ₃) content	"	(a)	(a)	(a)	(a)	(a)
Beryllium ore	tonnes	14	(a)	28	61	118
Beryllium oxide (BeO) content	mtu	174	(a)	338	678	1,386
Bismuth concentrate	tonnes	1,553	1,768	1,896	1,281	1,609
Bismuth content	kg	191,271	200,663	232,936	325,474	343,349
Copper content	tonnes	161	137	110	114	157
Gold content	'000 grams	796	670	1,004	2,239	2,026
Selenium content	tonnes	1	..	..	36	31
Silver content	'000 grams	210	134	175	436	520
Copper concentrate	tonnes	500,330	544,909	662,030	636,018	824,772
Copper content	"	114,914	129,704	161,575	159,239	186,763
Bismuth content	kg	..	..	5,080	22,353	12,100
Gold content	'000 grams	2,830	2,821	2,800	2,985	2,463
Lead content	tonnes	1,056	937	777	341	633
Palladium content	'000 grams	..	..	2	..	..
Platinum content . . . . .	"	..	..	1	..	..
Silver content	"	31,736	3,341.1	35,343	32,342	38,343
Zinc content	tonnes	2,015	1,586	1,850	994	2,058
Copper ore	tonnes	45,500	82,575	30,783	18,890	12,504
Copper content	"	2,783	3,509	1,816	1,261	946
Gold content	'000 grams	11	25	1	..	1
Silver content	"	149	79	102	84	..
Copper ore for fertilizer	tonnes	1,233	897	304	152	3,048
Copper content	"	150	135	26	7	24
Copper oxide	tonnes	..	..	..	663	976
Copper content . . . . .	"	..	..	..	509	752
Copper precipitate	tonnes	618	302	278	247	170
Copper content	"	360	180	179	179	130
Gold content	'000 grams	11	1	3	..	..
Silver content	"	1	..	..	..	..
Gold bullion (b)	'000 grams	24,638	21,757	18,854	20,762	17,930
Gold content	"	17,853	15,627	14,053	16,179	13,938
Silver content	"	5,101	4,926	4,034	3,769	3,264
Gold ore	tonnes	6	914	1,087	..	..
Gold content	'000 grams	1	25	3	..	..
Iron ore (c)	'000 tonnes	32,541	45,119	57,110	62,103	74,645
Iron content	"	20,831	28,676	36,107	39,255	47,204
Iron oxide (d)	tonnes	46,941	58,401	64,080	66,908	86,569
Lead concentrate	tonnes	652,225	692,836	631,722	622,592	(e)582,178
Lead content	"	396,531	429,316	392,834	395,186	356,695
Antimony content	"	690	776	662	711	619
Cadmium content	"	61	48	89	83	53
Copper content	"	3,524	3,420	3,258	3,603	3,176
Gold content	'000 grams	357	348	324	382	312
Silver content	"	589,357	693,460	588,128	540,465	490,615
Sulphur content	tonnes	53,338	56,654	50,356	56,831	50,826
Zinc content	"	34,416	16,893	32,047	33,922	31,786
Lead-copper concentrate	tonnes	13,033	13,517	10,227	18,025	16,605
Lead content	"	4,833	4,671	3,018	5,126	5,034
Copper content	"	1,360	1,438	1,234	2,133	1,828
Gold content	'000 grams	711	788	750	1,260	1,038
Silver content	"	33,351	33,117	28,824	49,602	49,357
Sulphur content	tonnes	3,375	3,540	2,845	5,005	4,427
Zinc content	"	1,482	1,644	11,278	2,360	2,333

For footnotes see end of table.

QUANTITY OF MINERALS PRODUCED AND METALLIC CONTENTS OF ORES, CONCENTRATES, ETC.: AUSTRALIA—continued

Mineral		1968-69	1969-70	1970-71	1971-72	1972-73
METALLIC MINERALS—continued						
Lead ore (f)	tonnes	53,251	41,352	36,333	31,284	39,760
Lead content	"	3,623	2,412	2,020	1,774	2,553
Copper content . . . . .	"	..	..	..	..	4
Gold content	'000 grams	1	..	..	..	..
Silver content	"	4,841	3,568	2,337	2,044	3,480
Zinc content	"	521	188	27	18	63
Lead-zinc middlings	tonnes	3,298	37,949	23,400	20,055	26,553
Lead content	"	925	9,504	6,560	4,910	5,733
Antimony content	"	5	60	22	26	34
Cadmium content	"	1	38	7	22	29
Copper content	"	14	209	92	133	175
Gold content	'000 grams	2	..	21	17	23
Silver content	"	2,924	39,644	24,660	16,746	23,880
Sulphur content	tonnes	345	6,768	1,749	4,309	5,515
Zinc content	"	376	8,142	5,109	5,373	8,038
Manganese ore—						
Metallurgical grade	tonnes	846,963	792,408	785,840	1,163,614	1,295,357
Manganese content	"	372,654	390,104	367,475	554,616	624,042
Other grades	tonnes	235	371	315	96	16
Manganese content	"	150	111	82	28	4
Mineral sands (g)—						
Ilmenite concentrate	tonnes	667,231	789,350	886,758	(h)705,259	(h)720,996
Titanium dioxide content	"	363,596	440,271	482,382	398,243	396,514
Leucoxene concentrate	tonnes	8,870	9,553	12,863	12,541	10,465
Titanium dioxide content	"	7,909	8,437	11,304	11,112	9,336
Monazite concentrate	tonnes	4,296	4,124	4,146	5,148	4,534
Monazite content	"	3,936	3,831	3,842	4,735	4,148
Rutile concentrate	tonnes	316,663	372,033	374,768	355,675	318,698
Titanium dioxide content	"	305,270	354,420	359,512	343,378	305,962
Xenotime concentrate	tonnes	39	103	42	14	17
Yttrium oxide content	kg	7,399	21,404	9,647	3,658	4,318
Zircon concentrate	tonnes	347,204	376,708	417,974	390,515	373,024
Zirconium dioxide content	"	227,688	250,070	277,877	258,767	247,545
Molybdenite concentrate	tonnes	48	117	61	18	..
Molybdenum disulphide	kg	40,653	99,319	51,818	15,676	..
Nickel concentrate	tonnes	51,961	160,083	304,046	299,144	268,349
Nickel content	"	6,184	18,047	34,917	35,559	36,104
Cobalt content	"	101	173	336	167	203
Copper content	"	779	1,843	2,938	2,590	2,659
Palladium content	kg	15	..	28	..	..
Platinum content	"	10	17	..	..	..
Nickel ore	tonnes	..	..	..	..	(a)
Nickel content . . . . .	"	..	..	..	..	(a)
Pyrite concentrate	tonnes	134,935	154,758	235,355	261,481	198,096
Sulphur content	"	60,005	71,382	110,375	120,586	93,839
Gold content	kg	..	140	..	..	..
Silver content	"	..	28	..	..	..
Tantalite-colombite concentrate	kg	(a)	(a)	158,786	162,019	236,831
Tantalite-colombite content	"	(a)	(a)	63,230	76,217	84,744
Tin content	tonnes	19	..	(a)	..	..
Tin concentrates	tonnes	11,967	15,265	15,951	19,722	22,513
Tin content	"	7,380	8,543	8,749	10,912	11,625
Copper content	"	8	..	..	..	..
Tantalite-colombite content	kg	..	(a)	(a)	..	..
Tin-copper concentrate	tonnes	2,145	3,708	4,367	5,187	4,586
Tin content	"	137	163	174	157	129
Copper content	"	384	729	836	977	878

For footnotes see end of table.

QUANTITY OF MINERALS PRODUCED AND METALLIC CONTENTS OF ORES, CONCENTRATES, ETC.: AUSTRALIA—*continued*

<i>Mineral</i>		1968-69	1969-70	1970-71	1971-72	1972-73
METALLIC MINERALS—<i>continued</i>						
Tungsten concentrates—						
Scheelite concentrate . . .	tonnes	1,588	1,406	1,287	1,842	1,789
Tungstic oxide content . . .	m.t.u.	113,327	100,544	90,374	135,347	131,973
Wolfram concentrate . . .	tonnes	746	1,059	1,076	841	761
Tungstic oxide content . . .	m.t.u.	52,402	75,353	75,681	61,025	55,528
Bismuth content . . .	"	..	603	..	..	..
Wolfram ore . . .	tonnes	..	..	..	..	122
Tungstic oxide content . . .	m.t.u.	..	..	..	..	100
Zinc concentrate . . .						
Zinc content . . .	tonnes	798,554	889,809	770,887	867,143	865,248
Cadmium content . . .	"	420,972	467,472	403,757	454,874	462,717
Cobalt content . . .	"	1,479	1,253	1,369	1,520	1,547
Copper content . . .	"	115	138	110	116	107
Gold content . . .	"	869	1,018	900	1,167	1,226
Lead content . . .	'000 grams	138	160	125	188	201
Manganese content . . .	tonnes	10,695	12,516	11,223	13,431	14,360
Mercury content . . .	"	5,848	6,431	6,155	7,711	8,443
Silver content . . .	kg	1,566	1,466	662	483	512
Sulphur content . . .	'000 grams	39,352	47,433	47,574	54,677	61,023
Zinc ore . . .	tonnes	250,787	223,033	239,922	273,583	324,960
Zinc content . . .	"	11,380	..	254	..	..
	"	3,414	..	76	..	..
COAL						
Black coal . . .	'000 tonnes	43,334	48,498	49,720	53,549	59,755
Semi-anthracite . . .	"	25	7	1	..	..
Bituminous . . .	"	39,656	44,762	46,460	50,340	56,444
Sub-bituminous . . .	"	3,653	3,729	3,259	3,208	3,311
Brown coal (lignite)(i) . . .	"	19,060	19,771	19,168	19,998	20,922
Brown coal briquettes . . .	"	1,495	1,565	1,391	1,308	1,228
PETROLEUM (j)						
Crude oil . . .	'000 cu m	2,237	4,871	14,937	19,038	20,669
Natural gas . . .	mil. cu m	58	782	1,961	2,628	3,713
Natural gas condensate(k) . . .	cu m	1	133	1,433	6,125	9,532
Ethane(e) . . .	'000 cu m	..	481	5,380	3,087	27,436
Liquefied petroleum gases(l)—						
Propane . . .	'000 cu m	..	16	347	577	798
Butane . . .	'000 cu m	..	22	393	662	988
CONSTRUCTION MATERIALS(m)						
Sand . . .	'000 tonnes	17,575	17,139	17,413	19,501	21,869
Gravel . . .	"	11,240	12,168	12,993	12,871	14,520
Dimension stone . . .	"	301	276	186	410	288
Crushed and broken stone . . .	"	45,890	48,851	50,419	50,475	51,037
Other . . .	"	24,280	28,860	28,208	26,405	42,113

For footnotes see end of table.

QUANTITY OF MINERALS PRODUCED AND METALLIC CONTENTS OF ORES, CONCENTRATES, ETC.: AUSTRALIA—continued

Mineral		1968-69	1969-70	1970-71	1971-72	1972-73
OTHER NON-METALLIC MINERALS						
Asbestos	tonnes	745	747	751	3,077	32,358
Barite	"	46,310	39,977	54,008	23,750	23,175
Carbon dioxide	"	(a)	(a)	(a)	(a)	(a)
Clays—						
Brick and shale	'000 tonnes	7,385	7,678	7,078	7,872	8,098
Other(n)	"	1,224	1,470	1,410	1,209	1,321
Diatomite	tonnes	2,685	2,731	2,399	1,758	4,792
Dolomite	"	310,549	335,386	319,656	390,832	402,312
Felspar (including cornish stone)	"	5,833	3,648	3,382	2,948	2,916
Fluorspar	"	..	619	1,001	380	1,700
Garnet concentrate	"	328	336	422	525	111
Gypsum	"	938,050	861,700	952,901	1,010,573	961,717
Limestone (including shell and coral)	'000 tonnes	9,179	10,238	10,447	10,154	10,960
Lithium ores(o)	tonnes	830	777	739	1,930	695
Lithia (Li ₂ O) content	mtu	3,498	3,265	3,102	8,108	2,828
Magnesite, crude	tonnes	23,718	23,539	19,664	18,684	21,822
Mineral pigments—red ochre	"	664	42	702	23	625
Peat(p)	"	2,168	3,277	3,678	4,489	(a)
Pebbles—for grinding	"	1,117	1,350	1,677	1,927	1,509
Perlite	"	808	1,399	1,773	295	1,834
Phosphate rock	"	10,726	18,463	9,164	2,512	1,494
Pyrophyllite	"	1,964	5,080	6,828	6,972	12,718
Salt	'000 tonnes	1,022	2,054	3,774	3,503	3,671
Silica	tonnes	743,797	786,528	955,048	1,012,445	1,168,819
Sillimanite	"	1,939	1,174	1,139	654	654
Talc (including steatite and chlorite)	"	42,172	60,059	44,532	43,997	47,927
Vermiculite . . . . .	"	..	..	360	171	636

(a) Not available for publication. (b) Includes alluvial gold. (c) Includes iron concentrate. (d) For cement manufacture, coal washing, flux and gas purification. (e) Excludes Western Australian production. (f) Includes silver-lead ore, silver-lead slimes and lead slag. (g) Details relating to rutile-zircon concentrates produced in one State and finally separated in another State are included in separated form in the data of the State of origin. (h) Includes Beneficiated Ilmenite. (i) Excludes brown coal used for briquette production. (j) Source: Department of Minerals and Energy and State Mines Departments. (k) Sales—excludes condensate blended and other petroleum products. (l) Excludes refinery production. (m) Incomplete see individual States. (n) Incomplete owing to difficulties of coverage. (o) Used mainly for non-metallic purposes. (p) Comprises peat for fertiliser and peat moss.

NOTE. Particulars of the production of uranium concentrate are not available for publication.

CONTENTS OF METALLIC MINERALS PRODUCED, 1972-73

<i>Contents of metallic minerals produced</i>	<i>N.S.W.</i>	<i>Vic.</i>	<i>Qld</i>	<i>S.A.</i>	<i>W.A.</i>	<i>Tas.</i>	<i>N.T.</i>	<i>Aust.</i>
Alumina (Al ₂ O ₃)	'000 tonnes	4	2	(a)	..	(a)	..	(a)
Antimony	tonnes	1,583	(a)	..	..	..	..	(a)
Beryllium oxide (BeO)	mtu(b)	..	..	..	1,386	..	..	1,386
Bismuth	kg	..	..	..	..	..	355,449	355,449
Cadmium	tonnes	1,066	..	398	..	165	..	1,629
Cobalt	"	107	..	..	203	..	..	310
Copper	"	15,320	..	135,283	2,798	26,751	8,905	198,718
Gold	'000 grams	301	141	1,742	99	9,264	1,769	20,002
Iron(c)	'000 tonnes	..	..	4,307	40,693	(d)1,696	508	47,204
Lead	tonnes	239,773	..	122,149	(e)22	(f)23,064	..	385,008
Manganese(g)	"	5,489	..	..	14,525	2,954	609,517	632,485
Manganese dioxide (MnO ₂)(h) . . . . .	"	..	..	4	..	..	..	4
Mercury	kg	..	..	..	..	512	..	512
Monazite	tonnes	1,774	..	26	..	2,348	..	4,148
Nickel . . . . .	"	..	..	..	36,104	..	..	36,104
Selenium	kg	..	..	..	..	..	31	31
Silver	'000 grams	281,739	..	292,884	1,630	2,616	86,749	670,482
Sulphur(i)	tonnes	272,768	..	63,034	..	..	143,765	479,567
Tantalite-columbite (Ta ₂ O ₅ + Nb ₂ O ₅)	kg	..	..	..	84,744	..	..	84,744
Tin	tonnes	2,998	5	1,342	..	972	19	11,754
Titanium dioxide (TiO ₂)	"	213,571	..	94,336	990	402,915	..	711,812
Tungstic oxide (WO ₃)	mtu(b)	201	100	7,900	..	..	179,400	187,601
Yttrium oxide (Y ₂ O ₃)	kg	..	..	..	4,318	..	..	4,318
Zinc	tonnes	316,817	..	117,525	..	..	72,653	506,995
Zirconium dioxide (ZrO ₂)	"	161,403	..	48,805	..	37,337	..	247,545

(a) Not available for publication. (b) Metric ton unit (mtu) equals 10 kilograms. (c) Excludes iron content of iron oxide not intended for metal extraction. (d) Contained in iron concentrate. (e) Includes lead content of Western Australian lead concentrate. (f) Included with lead content of South Australian lead ore. (g) Content of metallurgical grade manganese ore and zinc concentrate. (h) Content of manganese ore of other than metallurgical grade. (i) Sulphur content of pyrite and other minerals from which sulphur is recovered.

CONTENTS OF METALLIC MINERALS PRODUCED: AUSTRALIA

<i>Contents of metallic minerals produced</i>	<i>1968-69</i>	<i>1969-70</i>	<i>1970-71</i>	<i>1971-72</i>	<i>1972-73</i>
Alumina (Al ₂ O ₃)	'000 tonnes	(a)	(a)	(a)	(a)
Antimony	tonnes	868	969	1,386	1,120
Beryllium oxide (BeO)	mtu(b)	174	(a)	338	678
Bismuth	'000 grams	191,271	201,266	238,016	347,778
Cadmium	tonnes	1,541	1,339	1,465	1,625
Cobalt	"	216	311	446	283
Copper	"	125,306	142,322	172,965	171,920
Gold	'000 grams	22,711	20,605	19,103	23,253
Iron(c)	'000 tonnes	(d)20,831	(d)28,676	(d)36,107	(d)39,255
Lead	tonnes	417,663	459,357	416,432	420,797
Manganese(e)	"	378,502	396,535	373,630	562,327
Manganese dioxide (MnO ₂)(f)	"	150	111	82	28
Mercury	kg	1,566	1,466	662	483
Molybdenum disulphide (MoS ₂)	"	40,653	99,319	51,818	15,676
Monazite	tonnes	3,936	3,831	3,842	4,735
Nickel	"	6,184	18,047	34,917	35,559
Palladium	grams	9,979	482	1,758	..
Platinum	"	14,713	17,208	29,484	..
Selenium	tonnes	..	..	..	36
Silver	'000 grams	707,022	855,926	731,178	700,165
Sulphur(g)	tonnes	367,850	361,377	405,247	460,313
Tantalite-columbite (Ta ₂ O ₅ + Nb ₂ O ₅)	'000 grams	(a)	(a)	63,799	76,217
Tin	tonnes	7,536	8,706	8,923	11,070
Titanium dioxide (TiO ₂)	"	676,775	803,128	853,198	752,733
Tungstic oxide (WO ₃)	mtu(b)	165,729	175,897	166,061	196,372
Yttrium oxide (Y ₂ O ₃)	'000 grams	7,399	21,404	9,647	3,658
Zinc	tonnes	463,195	520,825	444,144	497,541
Zirconium dioxide (ZrO ₂)	"	227,688	250,070	277,877	258,767

(a) Not available for publication. (b) Metric ton unit (mtu) equals 10 kilograms. (c) Excludes iron content of iron oxide not intended for metal extraction. (d) Includes iron contained in iron concentrate. (e) Content of metallurgical grade manganese ore and zinc concentrate. (f) Content of manganese ore of other than metallurgical grade. (g) Sulphur content of pyrite and other minerals from which sulphur is recovered.

NOTE. Particulars of production of uranium oxide (U₃O₈) are not available for publication.

MINE PRODUCTION OF PRINCIPAL METALS: AUSTRALIA

1941 TO 1972-73

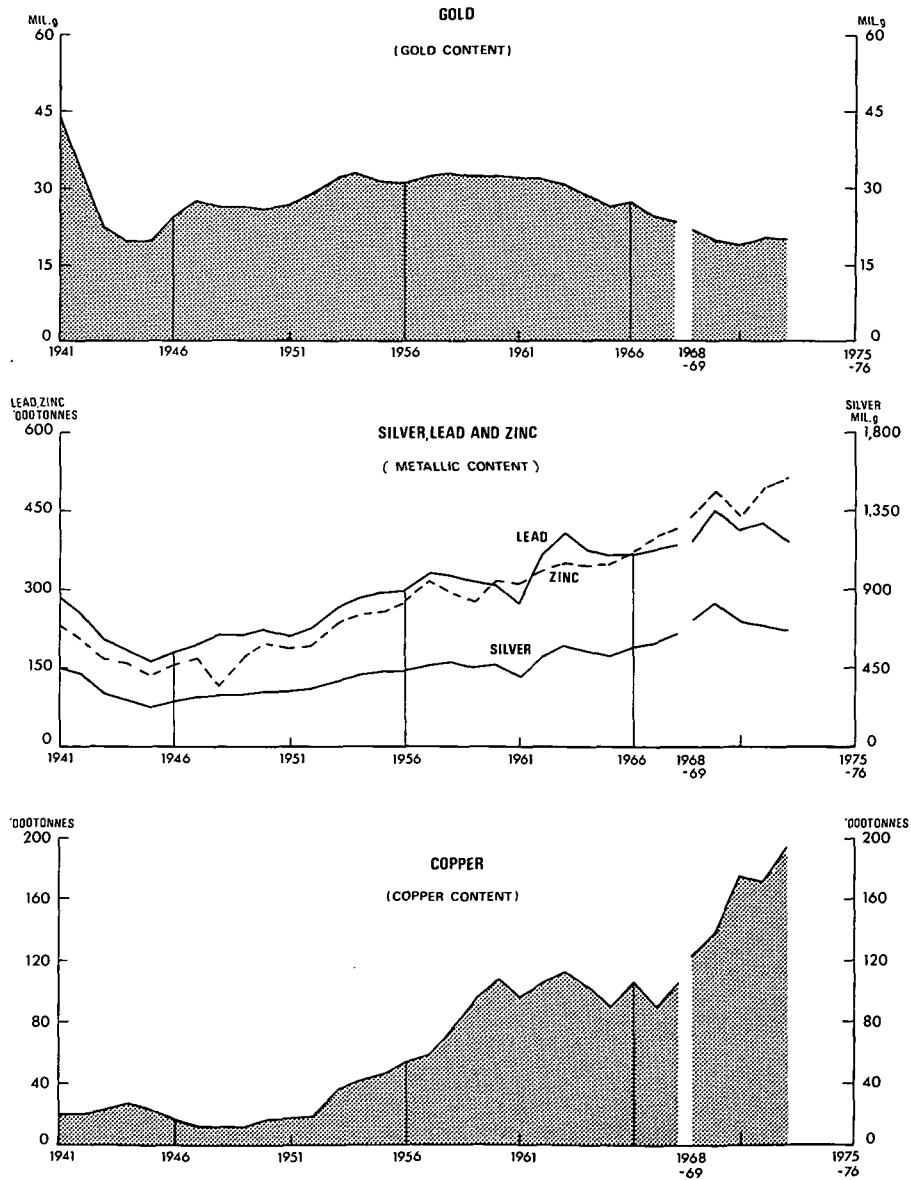


PLATE 56

MINE PRODUCTION OF PRINCIPAL METALS
AND PRODUCTION OF COAL
AUSTRALIA 1941 TO 1972-73

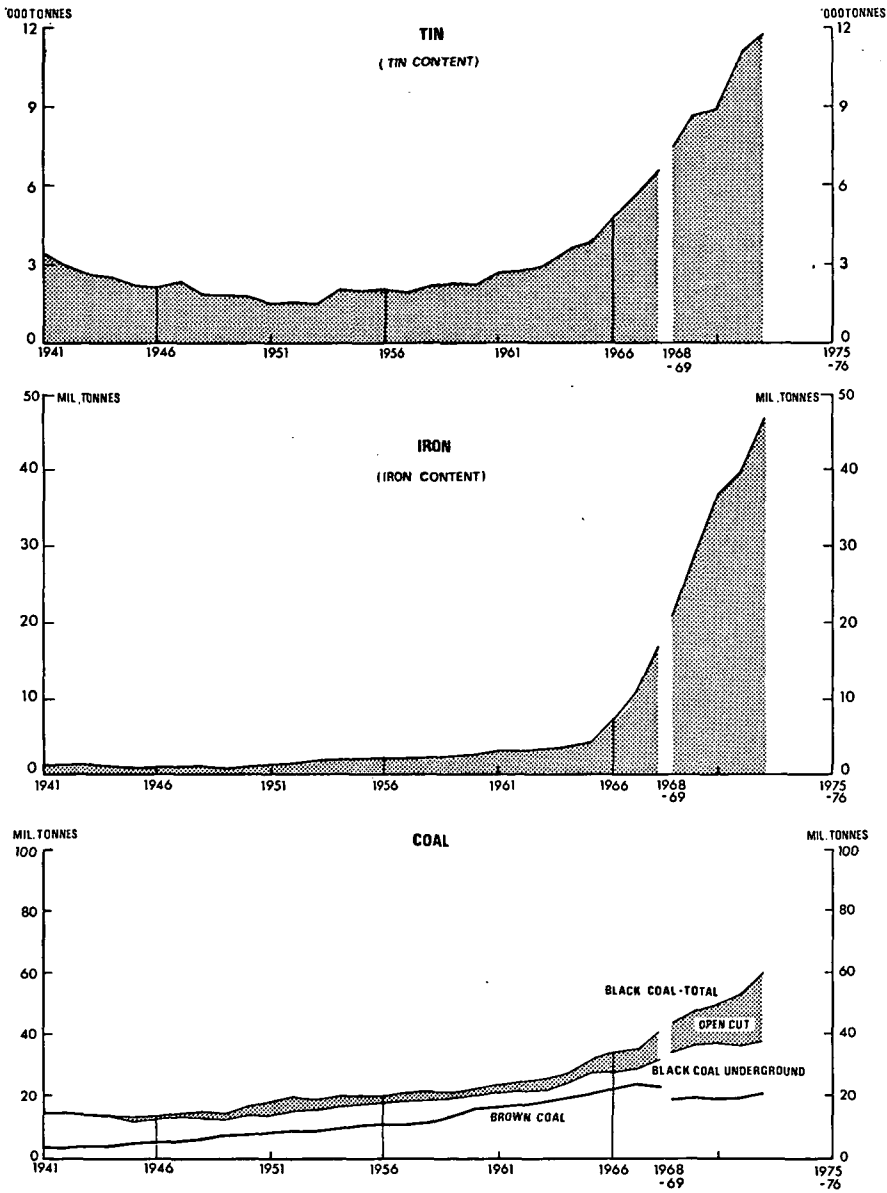
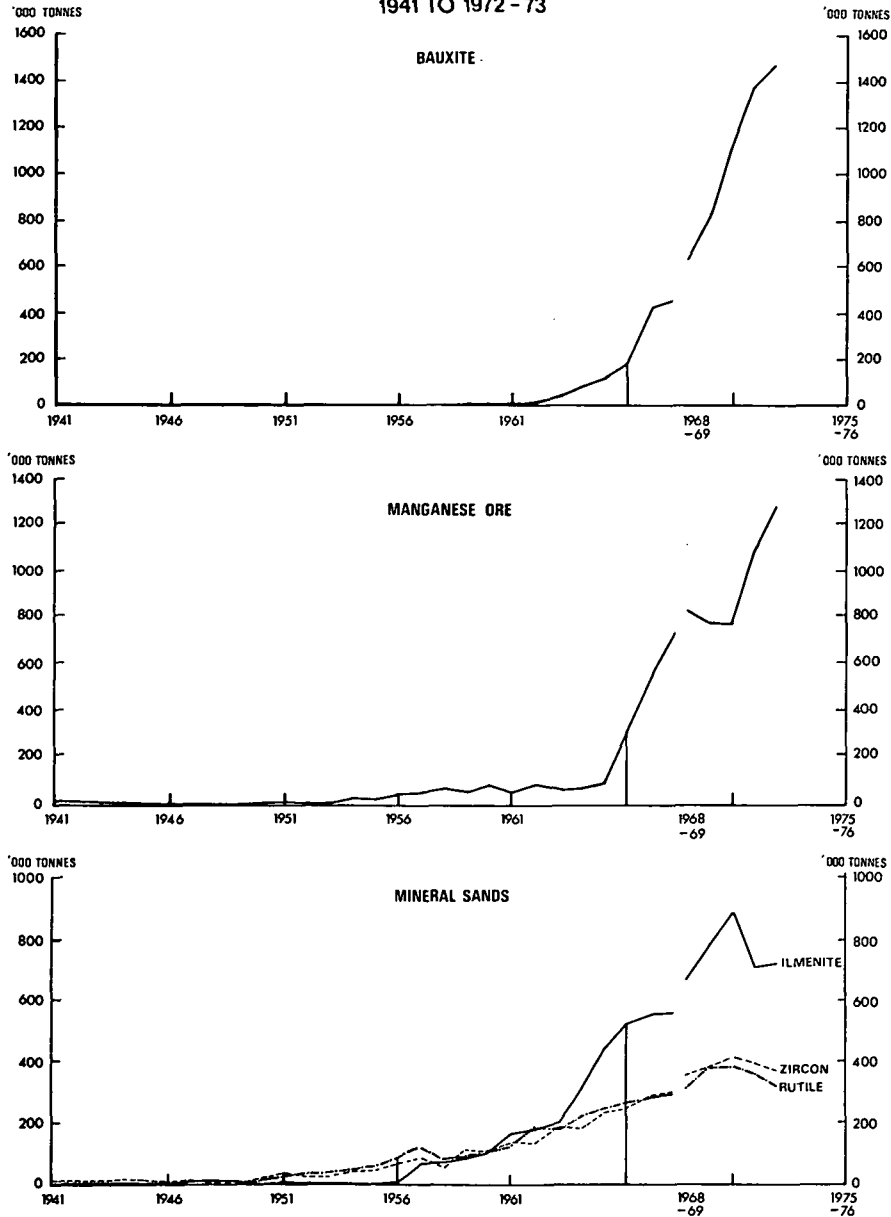


PLATE 57

MINE PRODUCTION OF PRINCIPAL METALS: AUSTRALIA

1941 TO 1972 - 73



Note. Prior to 1968-69 mineral figures were collected on a calendar year basis.

Value of minerals produced

The following table shows the value of minerals produced in the past five years.

VALUE OF MINERALS PRODUCED: AUSTRALIA
(\$'000)

Mineral	1968-69	1969-70	1970-71	1971-72	1972-73
METALLIC MINERALS					
Antimony—					
Concentrate	83	84	422	176	546
Ore . . . . .	..	1	83	(a)	(a)
Bauxite	(a)	(a)	(a)	(a)	(a)
Beryllium ore	7	(a)	9	16	23
Bismuth concentrate	2,087	2,441	2,672	5,066	6,813
Copper—					
Concentrate	103,872	145,246	129,752	114,956	154,748
Ore(b)	2,073	2,874	(c)	947	701
Ore for fertiliser	136	97	18	6	9
Oxide . . . . .	..	..	..	475	757
Precipitate	352	232	148	134	101
Gold—					
Bullion(c)	22,919	19,945	17,779	21,435	25,730
Ore . . . . .	..	26	3	..	..
Iron ore	193,246	258,950	343,682	372,483	395,189
Iron oxide	542	645	754	773	1,150
Lead concentrate	80,598	99,507	75,825	(d)69,340	(d)72,060
Lead-copper concentrate	4,043	4,760	3,031	4,444	6,089
Lead ore(e)	797	463	398	321	494
Lead-zinc middlings	303	3,032	2,269	1,846	2,560
Manganese ore	10,734	9,680	10,852	(a)	(a)
Mineral sands—					
Ilmenite concentrate	5,380	6,638	7,434	(f)8,071	(f)8,155
Leucoxene concentrate	358	420	975	1,089	722
Monazite concentrate	501	493	530	608	551
Rutile concentrate	23,388	31,246	37,214	41,023	36,510
Xenotime concentrate	76	119	54	18	22
Zircon concentrate	11,481	11,827	13,207	12,503	11,821
Molybdenite concentrate	76	175	85	17	..
Nickel concentrate	(a)	(a)	(a)	(a)	(a)
Nickel ore . . . . .	..	..	..	..	(a)
Pyrite concentrate	1,713	1,473	2,190	2,230	139
Tantalite-columbite concentrate	(b)	(b)	936	835	670
Tin concentrate	19,199	26,744	25,533	30,406	32,282
Tin-copper concentrate	469	915	905	659	516
Tungsten ores and concentrates	6,725	8,753	9,044	7,979	5,550
Zinc concentrate	25,385	45,974	43,548	63,393	61,820
Zinc ore	112	..	2	..	..
<i>Total metallic minerals</i>	<i>562,804</i>	<i>761,600</i>	<i>845,423</i>	<i>921,642</i>	<i>995,366</i>
COAL					
Black coal	198,713	246,383	283,245	330,504	390,980
Brown coal (lignite)(g)	16,947	18,055	19,052	21,768	24,716
Brown coal briquettes	12,306	11,514	10,614	11,280	9,173
<i>Total coal</i>	<i>227,966</i>	<i>275,953</i>	<i>312,911</i>	<i>363,553</i>	<i>424,869</i>
PETROLEUM(h)					
Petroleum	40,098	88,532	216,722	271,981	311,903

For footnotes see next page.

VALUE OF MINERALS PRODUCED: AUSTRALIA—*continued*
(\$'000)

<i>Mineral</i>	<i>1968-69</i>	<i>1969-70</i>	<i>1970-71</i>	<i>1971-72</i>	<i>1972-73</i>
CONSTRUCTION MATERIALS(f)					
<i>Construction materials</i>	<i>117,113</i>	<i>134,638</i>	<i>144,708</i>	<i>159,031</i>	<i>170,484</i>
OTHER NON-METALLIC MINERALS					
Asbestos	180	174	170	(j)453	3,256
Barite	409	437	476	202	208
Carbon dioxide	24	50	42	38	47
Clay—					
Brick clay and shale	7,042	7,682	7,105	8,408	9,355
Other clays	1,828	2,537	2,648	2,385	2,682
Diatomite	21	21	20	17	43
Dolomite	699	825	747	844	888
Felspar (including cornish stone)	57	49	45	38	35
Fluorspar	..	14	32	22	79
Garnet concentrate	5	4	6	8	2
Gems	9,261	14,541	17,830	27,262	40,911
Gypsum	2,351	2,238	2,577	2,819	2,826
Limestone (including shell and coral)	13,380	14,431	15,110	15,135	16,932
Lithium ores	13	12	12	30	11
Magnesite, crude	238	272	233	236	318
Mineral pigments—red ochre	10	1	7	..	10
Peat(k)	25	59	62	87	(a)
Pebbles—for grinding	17	24	30	38	36
Perlite	5	14	18	3	18
Phosphate rock	42	73	27	10	6
Pyrophyllite	22	45	68	58	112
Salt	4,246	7,947	11,563	11,804	12,655
Silica	1,775	2,542	3,276	3,555	4,484
Sillimanite	44	30	27	17	17
Talc (including steatite and chlorite)	617	946	732	782	(a)
Vermiculite	..	..	2	1	35
<i>Total other non-metallic minerals</i>	<i>42,312</i>	<i>54,966</i>	<i>62,866</i>	<i>74,253</i>	<i>95,943</i>
TOTAL					
Total, all minerals and construction materials	990,292	1,315,689	1,582,632	1,790,460	1,998,565
<i>Of which—</i>					
New South Wales	314,802	388,285	392,265	427,306	454,302
Victoria	69,007	112,604	249,422	312,375	349,973
Queensland	209,273	278,142	293,751	318,835	399,192
South Australia	72,159	85,005	92,524	94,169	116,807
Western Australia	234,973	339,959	446,507	510,409	536,414
Tasmania	59,163	77,631	74,169	81,972	84,863
Northern Territory	29,365	32,528	32,274	43,554	54,923
Australian Capital Territory	1,550	1,535	1,719	1,839	2,093

(a) Not available for publication. (b) Includes value of copper slag. (c) Includes alluvial gold. (d) Excludes value of Western Australian production. (e) Includes value of silver-lead ore, silver-lead slimes and lead slag. (f) Includes beneficiated ilmenite. (g) Excludes value of coal used in making briquettes. (h) The values shown are estimates based on prices prescribed in legislation quoted market prices and information from government departments. Includes values for crude oil, natural gas, natural gas condensate, ethane, propane and butane. (i) Incomplete owing to difficulties of coverage in some States. (j) Excludes Western Australian production. (k) Comprises peat for fertiliser and peat moss.

Foreign ownership and control of the mining industry in Australia

Set out below is a summary of the results of studies of foreign ownership and control of the mining industry in Australia for 1971-72 and 1972-73. These studies are the first conducted since the 1968 survey of overseas participation in Australian mining industry. For details of the 1968 study see Year Book No. 57, pages 932-5.

The statistics presented here are based on data collected in the Census of Mining Establishments for the financial years 1971-72 and 1972-73, and ownership and control characteristics as at 30 June 1972 and 30 June 1973 derived from information collected in the Survey of Overseas Investment. The figures for 1972-73 are based on the *preliminary* results of the 1972-73 Census of Mining Establishments.

The industry scope is the same as that of the Census of Mining Establishments, namely all of Division B, Mining, of the Australian Standard Industrial Classification (ASIC) excluding Sub-division 16, 'Services to mining' (which includes establishments mainly engaged in mineral exploration).

In the following tables the extent of foreign ownership and control is expressed in terms of *value added* (see page 968). Further details in terms of purchases, transfers in and selected expenses, turnover, fixed capital expenditure, wages and salaries, and employment, together with a more comprehensive treatment of the scope and conceptual basis of the statistics may be found in the bulletin *Foreign Ownership and Control of the Mining Industry, 1972-73*, (10.42).

Measurement of foreign ownership

In the foreign ownership statistics shown below, the classification by country is based on the country of domicile of the *immediate foreign owner* of the ordinary shares of the enterprise which operates (of which is connected to the enterprises which operates) the mining establishment. This may not necessarily correspond with the country of ultimate ownership as the immediate foreign owner may be a company which is in turn owned by residents of a different country.

VALUE ADDED APPORTIONED TO TOTAL FOREIGN OWNERSHIP, BY COUNTRY AND AUSTRALIAN OWNERSHIP

	Amount (\$ million)		Per cent	
	1971-72	1972-73	1971-72	1972-73
Foreign ownership—				
United Kingdom	233	251	16.2	15.7
U.S.A.	365	423	25.5	26.4
Other countries	99	120	6.9	7.5
<i>Total foreign ownership</i>	698	794	48.7	49.6
Australian ownership	736	807	51.3	50.4
<i>Total</i>	1,434	1,601	100.0	100.0

FOREIGN OWNERSHIP AND CONTROL OF THE MINING
INDUSTRY IN AUSTRALIA

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VALUE ADDED APPORTIONED TO DIRECT FOREIGN OWNERSHIP
OTHER IDENTIFIED FOREIGN OWNERSHIP, AND AUSTRALIAN OWNERSHIP
BY INDUSTRY CLASS

	Amount (\$ million)		Per cent	
	1971-72	1972-73	1971-72	1972-73
METALLIC MINERALS (ASIC SUB-DIVISION 11)				
Apportioned to direct foreign ownership	287	311	38.1	37.7
Apportioned to other identified foreign ownership	116	121	15.4	14.7
Total foreign ownership	403	431	53.4	52.3
Apportioned to Australian ownership	351	393	46.6	47.7
<i>Total</i>	<i>754</i>	<i>824</i>	<i>100.0</i>	<i>100.0</i>
TOTAL COAL AND CRUDE PETROLEUM (including NATURAL GAS) (ASIC SUB-DIVISIONS 12 and 13)				
Apportioned to direct foreign ownership	237	295	43.2	46.3
Apportioned to other identified foreign ownership	43	49	7.8	7.7
Total foreign ownership	280	344	51.1	54.0
Apportioned to Australian ownership	268	293	48.9	46.0
<i>Total</i>	<i>548</i>	<i>637</i>	<i>100.0</i>	<i>100.0</i>
TOTAL CONSTRUCTION MATERIALS (ASIC SUB-DIVISION 14)				
Apportioned to direct foreign ownership	1	1	1.0	0.9
Apportioned to other identified foreign ownership	8	7	7.7	6.6
Total foreign ownership	8	8	7.7	7.5
Apportioned to Australian ownership	96	98	92.3	92.5
<i>Total</i>	<i>104</i>	<i>106</i>	<i>100.0</i>	<i>100.0</i>
TOTAL OTHER NON-METALLIC MINERALS (ASIC SUB-DIVISION 15)				
Apportioned to direct foreign ownership	5	9	18.5	26.5
Apportioned to other identified foreign ownership	1	2	3.7	5.9
Total foreign ownership	6	11	22.2	32.4
Apportioned to Australian ownership	21	23	77.8	67.6
<i>Total</i>	<i>27</i>	<i>34</i>	<i>100.0</i>	<i>100.0</i>
TOTAL MINING (ASIC SUB-DIVISIONS 11-15)				
Apportioned to direct foreign ownership	530	615	37.0	38.4
Apportioned to other identified foreign ownership	168	179	11.7	11.2
Total foreign ownership	698	794	48.7	49.6
Apportioned to Australian ownership	736	807	51.3	50.4
<i>Total</i>	<i>1,434</i>	<i>1,601</i>	<i>100.0</i>	<i>100.0</i>

**VALUE ADDED APPORTIONED TO DIRECT FOREIGN OWNERSHIP BY EXTENT OF
DIRECT FOREIGN OWNERSHIP, OTHER IDENTIFIED FOREIGN OWNERSHIP
AND AUSTRALIAN OWNERSHIP**

	<i>Amount (\$ million)</i>		<i>Per cent</i>	
	<i>1971-72</i>	<i>1972-73</i>	<i>1971-72</i>	<i>1972-73</i>
AppORTIONED TO DIRECT FOREIGN OWNERSHIP—				
Extent of direct foreign ownership—				
Less than 50 per cent	58	52	4.0	3.2
50 per cent and less than 75 per cent	219	339	15.3	21.2
75 per cent and over	253	224	17.6	14.0
<i>Total</i>	<i>530</i>	<i>615</i>	<i>37.0</i>	<i>38.4</i>
AppORTIONED TO OTHER IDENTIFIED FOREIGN OWNERSHIP	168	179	11.7	11.2
Total foreign ownership	698	794	48.7	49.6
AppORTIONED TO AUSTRALIAN OWNERSHIP	736	807	51.3	50.4
<i>Total</i>	<i>1,434</i>	<i>1,601</i>	<i>100.0</i>	<i>100.0</i>

Measurement of foreign control

The basis of the country classification used for the foreign control statistics shown below is the country of domicile of the direct foreign investor. When an enterprise in Australia has direct foreign investors in more than one country, mining establishments owned by that enterprise are classified on the basis of the country of domicile of those direct foreign investors which together account for the largest percentage of direct foreign ownership.

**NUMBER AND VALUE ADDED OF MINING ESTABLISHMENTS OF FOREIGN CONTROLLED
ENTERPRISES BY COUNTRY, AND AUSTRALIAN CONTROLLED ENTERPRISES**

	<i>Establishments, etc.</i>				<i>Value added</i>			
	<i>Number</i>		<i>Per cent</i>		<i>Amount(\$m)</i>		<i>Per cent</i>	
	<i>1971-72</i>	<i>1972-73</i>	<i>1971-72</i>	<i>1972-73</i>	<i>1971-72</i>	<i>1972-73</i>	<i>1971-72</i>	<i>1972-73</i>
Establishments of foreign controlled enterprises—								
United Kingdom	53	58	3.7	4.4	240	218	16.7	13.6
U.S.A.	37	38	2.6	2.9	494	641	34.4	40.0
Other Countries	30	30	2.1	2.3	45	57	3.1	3.6
<i>Total</i>	<i>120</i>	<i>126</i>	<i>8.4</i>	<i>9.5</i>	<i>779</i>	<i>916</i>	<i>54.3</i>	<i>57.2</i>
Establishments of Australian controlled enterprises	1,306	1,199	91.6	90.5	655	685	45.7	42.8
<i>Total</i>	<i>1,426</i>	<i>1,325</i>	<i>100.0</i>	<i>100.0</i>	<i>1,434</i>	<i>1,601</i>	<i>100.0</i>	<i>100.0</i>

**NUMBER AND VALUE ADDED OF MINING ESTABLISHMENTS OF FOREIGN CONTROLLED
ENTERPRISES AND AUSTRALIAN CONTROLLED ENTERPRISES, BY INDUSTRY GROUP**

	<i>Establishments, etc.</i>				<i>Value added</i>			
	<i>Number</i>		<i>Per cent</i>		<i>Amount (\$m)</i>		<i>Per cent</i>	
	1971-72	1972-73	1971-72	1972-73	1971-72	1972-73	1971-72	1972-73
TOTAL METALLIC MINERALS (ASIC SUB-DIVISION 11)								
Establishments of foreign controlled enterprises	49	48	17.6	21.1	398	447	52.8	54.2
Establishments of Australian controlled enterprises	229	180	82.4	78.9	356	377	47.2	45.8
<i>Total</i>	278	228	100.0	100.0	754	824	100.0	100.0
TOTAL COAL AND CRUDE PETROLEUM (including NATURAL GAS) (ASIC SUB-DIVISIONS 12 AND 13)								
Establishments of foreign controlled enterprises	43	45	29.7	33.6	374	455	68.2	71.4
Establishments of Australian controlled enterprises	102	89	70.3	66.4	174	182	31.8	28.6
<i>Total</i>	145	134	100.0	100.0	548	637	100.0	100.0
TOTAL CONSTRUCTION MATERIALS (ASIC SUB-DIVISION 14)								
Establishments of foreign controlled enterprises	9	11	1.2	1.6	1	2	1.0	1.9
Establishments of Australian controlled enterprises	717	691	98.8	98.4	103	104	99.0	98.1
<i>Total</i>	726	702	100.0	100.0	104	106	100.0	100.0
TOTAL OTHER NON-METALLIC MINERALS (ASIC SUB-DIVISION 15)								
Establishments of foreign controlled enterprises	19	22	6.9	8.4	6	11	22.2	32.4
Establishments of Australian controlled enterprises	258	239	93.1	91.6	21	23	77.8	67.6
<i>Total</i>	277	261	100.0	100.0	27	34	100.0	100.0
TOTAL MINING (ASIC SUB-DIVISIONS 11-15)								
Establishments of foreign controlled enterprises	120	126	8.4	9.5	779	916	54.3	57.2
Establishments of Australian controlled enterprises	1,306	1,199	91.6	90.5	655	685	45.7	42.8
<i>Total</i>	1,426	1,325	100.0	100.0	1,434	1,601	100.0	100.0

NUMBER AND VALUE ADDED OF MINING ESTABLISHMENTS OF FOREIGN CONTROLLED ENTERPRISES BY EXTENT OF DIRECT FOREIGN OWNERSHIP, AND AUSTRALIAN CONTROLLED ENTERPRISES BY EXTENT OF FOREIGN OWNERSHIP

	<i>Establishments, etc.</i>				<i>Value added</i>			
	<i>Number</i>		<i>Per cent</i>		<i>Amount (\$m)</i>		<i>Per cent</i>	
	1971-72	1972-73	1971-72	1972-73	1971-72	1972-73	1971-72	1972-73
Establishments of foreign controlled enterprises—Extent of direct foreign ownership—								
Less than 50 per cent	25	23	1.8	1.7	116	86	8.1	5.4
50 per cent and less than 75 per cent	44	51	3.1	3.8	373	589	26.0	36.8
75 per cent and over	51	52	3.6	3.9	289	241	20.2	15.1
<i>Total</i>	120	126	8.4	9.5	779	916	54.3	57.2
Establishments of Australian controlled enterprises—Extent of foreign ownership—								
Less than 25 per cent	1,258	1,181	88.2	89.1	403	500	28.1	31.2
25 per cent and over	48	18	3.4	1.4	252	185	17.6	11.6
<i>Total</i>	1,306	1,199	91.6	90.5	655	685	45.7	42.8
Total	1,426	1,325	100.0	100.0	1,434	1,601	100.0	100.0

Mineral exploration (other than for petroleum)

Definition

Mineral exploration (other than for petroleum) consists of the search for, and/or appraisal of, new ore occurrences and known deposits of minerals (including extensions to deposits being worked) by geological, geophysical, geochemical, and other methods (including drilling). Exploration for water is excluded. The construction of shafts and adits is included if primarily for exploration purposes. Excluded are mine development activities (which include the construction of drives, shafts, winzes, etc.) in underground mines and the preparation of quarrying sites for open-cut extraction (including overburden removal) carried out primarily for the purpose of commencing or extending mining and quarrying operations. Mine development activities (including mines under development) are included in the scope of the annual mining census.

Sources of statistics

The statistics of exploration for minerals *other than petroleum* are derived from the annual mineral exploration census, which is carried out by The Bureau of Statistics in each State and the Northern Territory, except in New South Wales where the census is conducted jointly with the State Mines Department.

Period covered

For 1968 and earlier years the annual mineral exploration census (excluding petroleum exploration) related to years ended 31 December. As from 1968-69, the reporting period for this census has related to years ended 30 June, to conform with a similar change in the annual mining census.

Scope of mineral exploration census

The scope of the census comprises the following activities.

(a) *Private exploration*—relates to exploration carried out by private enterprises and by business undertakings operated by State and local government authorities. Private exploration is further divided as follows.

(i) *Exploration on production leases*—relates to exploration carried out on the production lease by mines currently producing or under development for production of minerals. Mines included in this section of the mineral exploration census are also included in the annual mining census (see the statistical bulletin *Mining Establishments—Details of Operations* (Reference No. 10. 60) for further details).

- (ii) *Exploration on other licensed areas*—relates to exploration carried out on areas covered by exploration licences, authorities to enter, authorities to prospect, and similar licences and authorities issued by State governments for exploration for minerals.
- (iii) *Other exploration*—relates to exploration which is not directly connected with areas under lease, licence, etc. This category includes expenditure on general surveys, aerial surveys, report writing, map preparation and other off-site activities not directly attributable to particular lease or licence areas.
- (b) *Exploration by government*—relates to exploration for minerals carried out by—
 - (i) Australian Government (Bureau of Mineral Resources, Geology and Geophysics, and Joint Coal Board), and
 - (ii) State Mines Departments and the Mines Branch of the Department of the Northern Territory.

Employment in mineral exploration

In censuses prior to 1970-71 employment data were classified to one of the two categories: 'professional persons', and 'non-professional persons'. Employment data for working proprietors and working partners were, however, included in either one or the other of these categories. From 1970-71 separate details of man-weeks worked by 'working proprietors and working partners' were collected and are shown separately in the table on page 972.

Expenditure, employment, footage drilled, etc., States and Northern Territory

The following tables show expenditure, employment and footage drilled, etc., on mineral exploration other than for petroleum during the last five years.

MINERAL EXPLORATION (OTHER THAN FOR PETROLEUM)

EXPENDITURE(a) (\$'000)					
	1968-69	1969-70	1970-71	1971-72	1972-73
PRIVATE EXPLORATION					
New South Wales	7,272	16,562	21,238	15,093	12,673
Victoria	1,600	2,353	1,853	1,258	1,939
Queensland	18,018	25,078	32,662	22,119	15,465
South Australia	2,961	5,760	6,220	4,057	5,263
Western Australia	35,412	59,821	86,082	62,823	51,121
Tasmania	2,408	3,299	4,397	3,478	3,392
Northern Territory	4,891	5,241	8,610	8,233	9,885
<i>Total</i>	<i>72,562</i>	<i>118,115</i>	<i>161,063</i>	<i>117,061</i>	<i>99,738</i>
GOVERNMENT EXPLORATION					
Australian Government(b)	3,591	3,995	3,928	4,603	5,061
State Mines Departments	2,939	2,708	3,386	3,732	4,341
<i>Total</i>	<i>6,530</i>	<i>6,704</i>	<i>7,314</i>	<i>8,334</i>	<i>9,402</i>
TOTAL EXPENDITURE					
On drilling	26,196	33,522	45,106	32,905	29,073
Other	52,896	91,296	123,272	92,490	80,067
<i>Australia</i>	<i>79,092</i>	<i>124,818</i>	<i>168,377</i>	<i>125,396</i>	<i>109,140</i>

For footnotes see next page.

MINERAL EXPLORATION (OTHER THAN FOR PETROLEUM)—*continued*

EMPLOYMENT(c) (^{'000} man-weeks worked)					
	1968-69	1969-70	1970-71	1971-72	1972-73
PRIVATE EXPLORATION					
New South Wales	26.2	30.7	40.7	31.8	26.7
Victoria	6.3	5.7	5.1	3.4	5.1
Queensland	36.5	48.4	60.7	44.6	31.8
South Australia	9.2	10.9	11.2	9.0	7.6
Western Australia	67.5	103.3	135.5	114.5	96.1
Tasmania	7.4	8.8	11.4	7.5	7.5
Northern Territory	10.8	12.7	17.4	18.3	19.6
<i>Total</i>	163.9	220.5	282.1	229.0	194.3
GOVERNMENT EXPLORATION					
Australian(b)	11.7	16.5	18.1	14.5	16.3
State Mines Departments	17.0	20.9	21.1	22.8	23.7
<i>Total</i>	28.7	37.4	39.2	37.3	40.0
TOTAL					
By working proprietors and working partners	(d)	(d)	7.2	4.6	2.6
By professional persons(e)	57.6	73.1	94.5	94.4	90.4
By non-professional persons(f)	135.0	184.8	219.5	167.3	141.3
<i>Australia</i>	192.6	257.9	321.2	266.3	234.3
FOOTAGE DRILLED, SUNK OR DRIVEN(g) (^{'000} metres)					
PRIVATE EXPLORATION					
New South Wales	349	466	505	376	307
Victoria	43	42	30	19	27
Queensland	570	597	853	580	611
South Australia	76	187	199	123	343
Western Australia	760	1,934	2,030	2,030	1,410
Tasmania	54	59	94	67	65
Northern Territory	107	89	136	114	177
<i>Total</i>	1,960	3,373	3,849	3,308	2,938
GOVERNMENT EXPLORATION					
Australian(b)	7	8	3	2	..
State Mines Departments	96	86	84	71	70
<i>Total</i>	102	95	86	73	70
TOTAL FOOTAGE DRILLED, SUNK OR DRIVEN					
Drilled—core	805	928	949	794	769
non-core	1,194	2,469	2,811	2,514	2,181
Sunk or driven	64	71	175	73	58
<i>Australia</i>	2,063	3,468	3,935	3,381	3,008

(a) Expenditure whether charged as working expenses or capitalised. (b) Bureau of Mineral Resources and Joint Coal Board. (c) Operator and staff only (includes time spent on report writing and similar off-site activities associated with exploration); excludes contractors and their employees. (d) Not collected separately prior to 1970-71. Included in professional and non-professional employment. *see text page 971.* (e) Geologists, geophysicists, engineers, etc., engaged on exploration work. (f) Drill operators, field hands, etc. (g) 'Sunk or driven' relates to shafts, winzes, etc., sunk, and drives, adits, etc., driven.

Petroleum exploration

Source of statistics

These statistics were collected and compiled by the Bureau of Mineral Resources, Geology and Geophysics, Canberra. Statistical and other information relating to petroleum exploration is published by the Bureau of Mineral Resources in *The Petroleum Newsletter* (issued quarterly) and *The Australian Mineral Industry—Annual Review*.

Scope

Petroleum exploration consists of the search for, and/or appraisal of, deposits of crude oil and/or natural gas and natural gas liquids by geological, geophysical, geochemical, and other exploration methods, including drilling. Included in the expenditure are the costs of drilling exploratory oil and/or gas wells and the testing of such wells. Also included are the cost of access roads, site construction, permits, licences and similar fees, relevant office buildings and furniture, transportation equipment, storage facilities, plant and equipment, and review work, where these are undertaken primarily for purposes of exploration for deposits of petroleum. Details of developmental oil and/or gas wells are excluded.

Operations

The following tables show particulars of expenditure, and wells and footage drilled in petroleum exploration in recent years.

EXPENDITURE ON PETROLEUM EXPLORATION BY PRIVATE ENTERPRISE AND BY GOVERNMENTS: AUSTRALIA (\$'000)

	1968	1969	1970	1971	1972
PRIVATE SOURCES(a)					
Utilised in—					
New South Wales	1,126	2,473	2,597	287	200
Victoria	19,538	18,415	11,538	1,453	15,076
Queensland	5,183	7,058	5,474	3,011	3,085
South Australia	2,979	3,669	6,431	7,084	9,804
Western Australia	21,532	26,194	29,557	41,872	57,903
Tasmania	999	1,837	4,708	1,939	991
Northern Territory	6,222	7,064	13,753	17,250	10,350
<i>Total</i>	<i>57,579</i>	<i>66,711</i>	<i>74,059</i>	<i>72,896</i>	<i>97,408</i>
GOVERNMENT SOURCES					
Payments under <i>Petroleum Search Subsidy Act</i> 1959–1969—					
Utilised in—					
New South Wales	474	548	406	225	64
Victoria	1,940	441	732	231	570
Queensland	1,419	1,524	1,623	500	367
South Australia	1,407	609	923	537	611
Western Australia	4,027	6,286	4,604	3,599	4,209
Tasmania	497	903	395	208	16
Northern Territory	1,448	2,561	1,061	695	380
<i>Total subsidy payments</i>	<i>11,213</i>	<i>12,871</i>	<i>9,744</i>	<i>5,986</i>	<i>6,218</i>
Utilised for—					
Geophysical	3,590	3,557	2,924	2,470	3,230
Drilling	7,622	9,315	6,820	3,517	2,987
Other Government sources—					
Australian Government(a)	4,756	4,238	3,841	4,696	4,748
State Mines Departments	783	832	456	458	564
<i>Total other Government sources</i>	<i>5,540</i>	<i>5,070</i>	<i>4,296</i>	<i>5,155</i>	<i>5,312</i>
<i>Total Government sources</i>	<i>16,752</i>	<i>17,941</i>	<i>14,040</i>	<i>11,140</i>	<i>11,530</i>
TOTAL FUNDS, PRIVATE AND GOVERNMENT					
<i>Grand total</i>	<i>74,330</i>	<i>84,652</i>	<i>88,099</i>	<i>84,037</i>	<i>108,938</i>

(a) Excludes payments under the *Petroleum Search Subsidy Act* 1959–1969.

**SUMMARY OF EXPLORATION WELLS AND METRES DRILLED IN PETROLEUM
EXPLORATION, 1972**

		<i>N.S.W.</i>	<i>Vic.</i>	<i>Qld</i>	<i>S.A.</i>	<i>W.A.</i>	<i>Tas.</i>	<i>N.T.</i>	<i>Total</i>
Wells—									
Drilled (i.e. those which reached final depth)—									
As oil producers	No.	..	..	..	1	2	..	..	3
As gas producers	No.	..	..	3	8	6	..	..	17
Plugged and abandoned	No.	1	11	16	8	37	4	5	82
Total	No.	1	11	19	17	45	4	5	102
Average final depth of wells drilled	m	1,148	2,206	1,200	2,620	2,016	2,993	2,159	2,213
Drilling still in progress at 31 December (uncompleted holes)	No.	..	1	..	1	6	..	1	9
Wells drilled or drilling over 3,000 metres	No.	..	..	1	3	16	..	..	20
Metres drilled—									
Completed wells	m	1,148	24,266	26,024	41,916	88,717	11,971	10,794	204,836
Uncompleted holes	m	..	890	..	2,831	14,787	..	1,087	19,595
Total	m	1,148	25,156	26,024	44,747	103,504	11,971	11,881	224,431

**SUMMARY OF EXPLORATION WELLS AND METRES DRILLED IN PETROLEUM
EXPLORATION: AUSTRALIA**

		<i>1968</i>	<i>1969</i>	<i>1970</i>	<i>1971</i>	<i>1972</i>
Wells—						
Drilled (i.e. those which reached final depth)—						
As oil producers	No.	1	..	2	1	3
As gas producers	No.	4	6	15	12	17
Plugged and abandoned	No.	78	101	108	62	82
Total	No.	83	107	125	75	102
Average final depth of wells drilled	m	1,870	1,881	1,634	2,274	2,213
Drilling still in progress at 31 December (uncompleted holes)	No.	8	11	8	8	9
Wells drilled or drilling over 3,000 metres	No.	13	24	19	23	20
Metres drilled—						
Completed wells	m	138,171	184,307	192,552	153,344	204,836
Uncompleted holes	m	17,596	21,617	16,066	15,199	19,595
Total	m	155,767	205,924	208,618	168,543	224,431

Mineral processing and treatment

The extraction of minerals from ore deposits, as in mining and quarrying, is only part of the wider field of mineral technology. It is only in rare instances that minerals can be used directly in the form in which they are produced by mines, and, much more commonly, minerals must undergo considerable processing and treatment before their full utility and value can be realised. Examples of this processing and treatment are the smelting and refining of metals, the production of coke from coal, the refining of oil, and the treatment of non-metallic minerals as in the production of superphosphate and other chemicals and building materials like bricks and cement. The sectors of the economy which carry out this work are classified for statistical purposes to the manufacturing industry, and particulars relating to those activities which principally involve mineral processing and treatment—i.e. the treatment of non-metalliferous mine and quarry products, the manufacture of mineral oils and chemical fertilisers, the smelting, converting, refining and rolling of iron and steel, the extracting and refining of other metals, and the manufacture of alloys are given in Chapter 21, Manufacturing Industry.

Principal products

The following table shows particulars of the production of certain important manufactured products of mineral origin during recent years.

**PRODUCTION OF PRINCIPAL MANUFACTURED PRODUCTS
OF MINERAL ORIGIN: AUSTRALIA**

<i>Commodity</i>		<i>1968-69</i>	<i>1969-70</i>	<i>1970-71</i>	<i>1971-72</i>	<i>1972-73</i>
METALS(a)						
Non-ferrous—						
Alumina	tonnes	1,617,346	2,027,495	2,404,651	2,825,588	3,497,820
Refined aluminium	"	111,763	168,368	218,244	212,461	207,531
Blister copper(b)	"	111,341	110,599	130,199	144,791	149,355
Refined copper	"	96,252	105,344	115,321	130,827	136,435
Lead bullion (for export)(b)	"	134,340	171,719	179,424	141,582	138,925
Refined lead	"	178,482	188,341	154,937	190,638	173,561
Refined zinc	"	231,860	261,809	253,761	274,245	299,433
Refined tin	"	4,024	4,711	5,942	6,391	7,301
Ferrous—						
Pig iron(c)	'000 tonnes	5,795	5,956	6,240	6,006	7,182
Steel ingots(c)	"	6,813	7,086	6,800	6,585	7,235
Precious—						
Refined gold(d)	'000 grams	19,345	16,401	14,426	16,394	14,689
Refined silver	"	293,241	329,120	253,852	273,142	248,550
FUELS						
Coal products—						
Metallurgical coke	'000 tonnes	3,706	4,033	4,542	4,189	4,925
Brown coal briquettes	"	1,495	1,564	1,398	1,308	1,221
Petroleum products—						
Motor spirit	mil. litres	9,197	9,592	10,138	10,609	11,157
Furnace fuel	'000 tonnes	6,211	6,083	5,791	5,015	5,042
Automotive distillate	"	2,620	2,898	3,177	3,426	3,707
Industrial diesel fuel	"	1,055	1,097	1,120	1,112	1,055
BUILDING MATERIALS						
Clay bricks	millions	1,627	1,694	1,669	1,744	1,874
Portland cement	'000 tonnes	4,140	4,499	4,685	4,884	5,037
Plaster of paris	"	287	303	309	315	344
Plaster sheets	'000 sq m	26,602	30,211	34,365	34,591	39,796
CHEMICALS						
Sulphuric acid	'000 tonnes	1,881	1,762	1,612	1,756	2,265
Caustic soda	tonnes	107,171	112,436	119,678	127,857	121,610
Superphosphate(e)	'000 tonnes	3,882	3,579	3,115	3,612	4,918

(a) Excludes secondary metal with the exception of pig iron and steel ingots. (b) Metallic content. (c) Year ended 31 May. (d) Newly-won gold of Australian origin. (e) Includes double and triple superphosphate and ammonium phosphate expressed in terms of single superphosphate i.e. 22% P₂O₅ equivalent.

Overseas trade

Exports and imports

Data of imports and exports of minerals and mineral products have been extracted from the official trade statistics compiled in the Australian Bureau of Statistics. Particulars of the quantities and values (\$f.o.b. port of shipment) of the principal minerals and mineral products exported from and imported into Australia during recent years are shown in the following table.

**EXPORTS AND IMPORTS OF PRINCIPAL MINERALS AND MINERAL PRODUCTS
AUSTRALIA**

Commodity(a)	Quantity			Value (\$'000 f.o.b.)		
	1970-71	1971-72	1972-73	1970-71	1971-72	1972-73
EXPORTS(b)						
Non-ferrous—						
Copper—						
Concentrate tonnes	140,218	141,395	164,451	32,031	27,298	32,267
Blister "	6,972	5,868	7,728	8,992	5,643	9,896
Refined "	36,014	56,519	49,967	35,521	51,395	44,729
Matte, slags, etc. "	8,371	5,210	9,829	3,332	1,571	2,640
Lead—						
Concentrate "	83,096	93,537	74,145	16,290	15,961	12,441
Bullion "	179,811	137,865	142,270	56,455	38,279	44,940
Refined "	123,155	130,345	149,691	29,023	28,230	36,400
Slags and residues "	3,035	2,342	6,628	586	423	1,064
Zinc—						
Concentrate "	387,334	364,147	289,836	25,739	26,184	21,508
Refined "	136,664	190,428	203,777	35,671	56,825	61,979
Slags and residues "	5,853	5,809	5,011	513	504	617
Tin—						
Concentrate "	6,343	9,249	11,290	7,636	11,963	11,739
Refined "	1,450	2,156	3,939	4,535	6,573	12,026
Aluminium—						
Alumina '000 tonnes	1,807	2,626	2,966	95,125	132,042	155,453
Refined tonnes	79,661	96,313	81,344	35,962	38,886	30,767
Ferrous and alloy—						
Iron ore—						
Pellets '000 tonnes	5,628	5,420	7,987	62,802	58,274	76,494
Fines "	13,478	18,081	25,178	81,101	105,885	126,313
Lump "	29,215	26,738	33,171	231,485	211,330	236,285
Tungsten—						
Scheelite concentrate tonnes	1,224	1,789	1,553	3,607	4,332	3,019
Wolfram concentrate "	1,002	736	818	4,100	2,066	1,734
Pig iron "	389,722	527,856	687,124	21,587	23,581	27,286
Steel ingots, blooms "	117,210	296,275	743,169	9,596	18,967	48,377
Mineral sands—						
Ilmenite concentrate "	641,060	530,933	521,823	6,471	5,628	5,731
Rutile concentrate "	380,922	314,770	338,760	36,399	36,116	39,750
Zircon concentrate "	363,160	364,343	419,962	13,200	13,038	15,131
Precious—						
Gold, refined '000 grams	2,250	3,718	10,136	2,305	4,573	18,239
Silver, refined "	247,586	211,574	181,014	12,237	9,033	8,731
Coal, black '000 tonnes	18,997	21,826	25,751	193,725	237,592	290,703
Crude oil(c) '000 cu m	1,091	241	330	2,760	14,207	4,910

IMPORTS

Tin, refined tonnes	119	104	65	376	325	203
Nickel (pigs, anodes, etc.) "	2,138	1,241	1,060	8,781	3,178	2,677
Ferro-alloys "	37,841	27,941	27,203	11,660	8,234	7,801
Gold—						
Unrefined bullion(d) '000 grams	3,212	3,201	3,091	3,416	3,804	5,205
Refined "	254	17	160	232	27	233
Crude oil(e) '000 cu m	13,689	10,960	9,316	121,325	115,101	99,384
Asbestos tonnes	71,681	61,665	62,905	10,705	9,852	9,909
Diamonds—						
Industrial metric carats	744,802	567,075	807,960	3,106	2,360	3,099
Gemstone "	49,847	44,016	59,416	6,573	6,331	9,346
Phosphate rock '000 tonnes	2,108	1,642	2,282	22,174	18,157	22,647
Potassium fertilisers tonnes	153,268	145,911	165,412	4,793	4,118	4,701
Sulphur "	273,341	276,745	498,275	4,906	4,637	6,660

(a) In addition to the commodities listed, significant quantities of bauxite and nickel ores and concentrates are exported but details are not available for publication. (b) Quantities shown for metallic minerals are gross quantities, not metallic contents. (c) Includes also partly refined oil, topped crudes and enriched crudes. (d) Gold content. (e) Includes also partly refined oil, topped crudes, enriched crudes and refinery feed stock.

Considerable quantities of metallic ores, concentrates, slags, and residues are exported from Australia for refining overseas. The following table shows selected items exported during 1972-73 and their principal metallic content as estimated by assay.

**PRINCIPAL METALLIC CONTENTS OF SELECTED ORES AND CONCENTRATES
ETC., EXPORTED FROM AUSTRALIA, 1972-73**

Ores and concentrates, etc.	Metallic contents—estimated from assay							
	Copper	Lead	Zinc	Tin	Iron	Tungstic oxides	Gold	Silver
	tonnes	tonnes	tonnes	tonnes	'000 tonnes	tonnes	'000 grams	'000 grams
Copper concentrate	43,559	..	..	..	..	..	4,384	23,990
Blister copper	7,687	..	..	..	..	..	1,255	984
Copper matte, slags, etc.(a)	3,509	4,430	183	..	..	..	..	2,950
Lead concentrate	2,223	41,789	9,019	..	..	..	438	62,171
Lead bullion	11	141,436	..	..	..	..	..	292,521
Lead slags and residues	338	2,660	1,156	75	..	..	..	523
Zinc concentrate . . . . .	..	742	150,623	..	..	..	..	2,053
Zinc slags and residues	1	..	3,470	..	..	..	..	..
Tin concentrate	2	7	2	4,473	..	..	..	2
Iron ore—								
Pellets . . . . .	..	..	..	..	5,277	..	..	..
Fines . . . . .	..	..	..	..	15,392	..	..	..
Lump . . . . .	..	..	..	..	21,025	..	..	..
Scheelite concentrate . . . . .	..	..	..	..	..	979	..	..
Wolfram concentrate . . . . .	..	..	..	..	..	677	..	..
Total metallic content	57,330	191,064	164,453	4,548	41,694	1,656	6,077	385,194

(a) Includes copper matte, copper slags and residues and copper-lead dross and speiss.

Prices

The following table shows average prices of some principal refined metals and ores and concentrates on Australian and certain major overseas markets. Prices of minerals such as iron ore, coal and bauxite are not shown, as these minerals are commonly sold on a contract basis rather than on an open market basis.

**AVERAGE DAILY PRICES OF SELECTED METALS AND METALLIC ORES AND
CONCENTRATES: AUSTRALIAN AND OVERSEAS MARKETS**

(Source: Bureau of Mineral Resources, Geology and Geophysics)

METALS(a)										
Period	Tin			Nickel U.K. (£Sig— metric ton)	Aluminium		Gold		Silver	
	Aust. (\$A— ton)	L.M.E. (£Sig— metric ton)	Straits (\$Mal— picul)		Aust. (\$A—ton)	U.S.A. (USC—lb)	Premium markets	U.K. (\$US—f. oz)	Aust. (Ac—f. oz)	U.K. (Sig new pence— f. oz)
							Australia and Overseas			
1970-71 .	3,344.9	1,476.7	643.1	1,231.1	578.0	29.0	33.76	37.87	151.7	70.3
1971-72 .	3,306.3	1,435.8	629.7	1,246.5	578.0	26.7	39.74	46.89	126.9	58.6
1972-73 .	3,291.2	1,630.5	627.7	1,371.8	578.0	24.3	58.40	77.92	156.6	83.6
1972-73—										
Highest .	3,476.0	1,812.0	671.0	1,457.3	578.0	25.0	83.35	123.25	171.5	103.8
Lowest .	3,117.0	1,511.0	605.0	1,246.5	578.0	23.0	50.76	60.35	132.1	63.8
Period	Copper		Lead		Zinc		Prod. (£Sig— ton)	U.S.A (USC—lb)		
	Aust. (\$A— tonne)	L.M.E. (£Sig— metric ton)	Aust. (\$A— ton)	L.M.E. (£Sig— metric ton)	U.S.A. (USC—lb)	Aust. (\$A— ton)			L.M.E. (£Sig— metric ton)	
1970-71 .	(h)1,087.4	477.7	262.4	114.7	14.60	295.7	121.3	128.8	15.25	
1971-72 .	(b)976.6	427.9	237.9	106.7	14.72	343.0	141.4	150.0	17.21	
1972-73 .	990.3	508.6	250.0	137.8	15.63	355.5	177.2	174.3	19.41	
1972-73—										
Highest .	1,240.0	715.3	250.0	171.6	16.50	379.0	277.8	205.0	22.50	
Lowest .	925.9	416.5	250.0	120.8	14.50	343.0	145.6	150.0	18.00	

For footnotes see next page

**AVERAGE DAILY PRICES OF SELECTED METALS AND METALLIC ORES AND
CONCENTRATES: AUSTRALIAN AND OVERSEAS MARKETS—continued**

ORES AND CONCENTRATES								
Period	Tin		Ilmenite		Rutile		Zircon	
	<i>Tin</i> <i>Aust.</i> (\$A—ltu)	<i>Wolfram</i> <i>U.K.</i> (£Stg—mtu)	<i>Aust.</i> (\$A—ton)	<i>U.K.</i> (£Stg— metric ton)	<i>Aust.</i> (\$A— ton)	<i>U.K.</i> (£Stg— metric ton)	<i>Aust.</i> (\$A— ton)	<i>U.K.</i> (£Stg— metric ton)
1970-71 .	28.66	c22.80-36.75	11	7.50-11.50	145-150	76.00-81.00	35-39	25.25-28.50
1971-72 .	28.27	14.00-22.00	11-12	9.35-11.32	115-150	64.00-79.72	35-39	26.82-28.05
1972-73 .	27.93	14.00-19.15	10.5-12.0	9.35-11.32	115-125	64.00-87.00	35-39	26.82-38.00
1972-73— Highest.	29.18	19.15	12.0	11.32	125	87.00	39	38.00
Lowest .	26.78	14.00	10.5	9.35	115	64.00	35	26.82

(a) Where a daily price does not actually exist for a commodity, daily prices have been imputed from price data which are available. (b) \$ per ton. (c) £stg per long ton unit.

Details on monthly prices, and price specifications relating to each commodity in the table are contained in each issue of the bulletin, Minerals and Mineral Products (10. 19).

REVIEW OF RECENT DEVELOPMENTS IN THE AUSTRALIAN MINERAL INDUSTRY

Major developments in the Australian mineral industry, particularly during the last year, are reviewed briefly in subsequent parts of this section. Additional information on developments in the industry is available in *Australian Mineral Industry 1972 Review* published by the Bureau of Mineral Resources, Geology and Geophysics. That publication contains comprehensive reviews of mineral commodities of importance to the Australian economy, as well as a general review of the industry's performance during the year.

World industrial activity recovered strongly in 1973 following the economic recession of 1971 and early 1972. Improved economic conditions were accompanied by a marked improvement in mineral and economic markets particularly those of the United States of America, Japan and Europe. Surplus stocks accumulated in 1971-72 were liquidated and demand increased substantially to meet higher levels of consumption and to replenish depleted inventories. Increased demand and international currency realignments in 1973 combined to push mineral and metal prices to new heights and by the end of the year base metals were being quoted at record levels.

Most sectors of the Australian mineral industry responded to improved world demand and new production and export records were established in 1973 despite revaluation of the \$A in December 1972 and September 1973 and devaluation of the \$US in February 1973. Some of the contracts written in \$US were renegotiated and in many cases losses were largely offset by improved world prices to such an extent that the estimated ex-mine value of mineral production increased by 16.5 percent over 1972 to a new peak of \$2,175 million. The value of exports of mineral primary products in 1973 was \$1,669 million, an increase of 10 per cent over 1972.

In 1973 the bulk ores—bauxite, coal, iron ore and manganese ore—established new output records. Total production of base metal concentrates was maintained at 1972 levels. Mine production of copper increased substantially but this was balanced by an equivalent fall in mine production of zinc. Of the ferroalloy metals, mine output of nickel continued to expand while production of tungsten concentrates was reduced substantially in line with low world prices. Output of mineral sands which reached a peak in 1971 was held at the reduced 1972 level.

Bauxite

The history of the aluminium industry and recent significant developments in the industry were reviewed in previous issues of the Year Book (No. 51, page 1168 and No. 52, page 1048). The year 1973 was a period of continued growth in the industry both in mining and processing as detailed below.

In 1973 bauxite production capacity at Weipa, Queensland, increased to 10.5 million tonnes per annum following completion of a further stage in the development of the mine and associated township, and of ore treatment and loading facilities. Approximately 3 million tonnes from Weipa were used by the Gladstone, Queensland, alumina refinery in 1973; the remaining production is available for export. The refinery at Bell Bay, Tasmania, was closed down at the end of 1973.

Bauxite deposits at Gove, Northern Territory, covering reserves of the order of 250 million tonnes of ore, are being developed by a consortium of seven Australian and one overseas companies. The alumina plant at Gove now has a rated capacity of 1,000,000 tonnes annually.

Firm decisions have not yet been made to proceed with two other bauxite/alumina projects in Western Australia; one to mine bauxite from the Mount Saddleback area, the other to mine bauxite in the Chittering area for a refinery to be built near Muchea.

Alumina

Rated capacity of the alumina plant at Gladstone, Queensland, is now 2,000,000 tonnes per annum and at Kwinana, Western Australia, 1,250,000 tonnes. Bauxite supplies for the Kwinana refinery are obtained from deposits 50 km away at Jarrahdale, Western Australia, the reserves of which are assessed as at least 500 million tonnes. The alumina plant at Pinjarra, Western Australia, has a rated annual capacity of 700,000 tonnes.

Copper

Copper production at Mount Isa was increased to a rate of 153,000 tonnes yearly during the last half of 1973. Work completed in 1973 included new development between 19 and 21 level, commissioning of new service and hoisting shafts, extensions to the existing copper smelter and a new concentrator, as well as enlargement of ancillary facilities.

A new copper-gold ore body at Warrego has been developed near Tennant Creek, Northern Territory. The first stage of development cost \$21 million; it has an installed mining capacity of 500,000 tonnes of ore per annum and production commenced in 1973.

Since the beginning of 1967 the Australian producers' price has been adjusted regularly to reflect movements in the London Metal Exchange daily settlement price. Prices rose strongly during the first eight months of 1973 to a maximum of \$A1500 per tonne before falling slightly in September and October. The price recovered in November and December to close the year at \$A1420.

Iron

The major development of recent years has been the establishment in Australia of a large scale iron ore export industry based principally on steelmaking requirements in Japan. Exports of iron ore and iron ore pellets in 1973 to Japan and elsewhere were 74 million tonnes valued at \$459 million.

New mines began production in the Pilbara, Western Australia, in 1973, at Shay Gap, Sunrise Hill and Paraburdoo; programs to expand production capacity continued in early 1974 at Robe River, Mount Whaleback and Paraburdoo.

Lead and zinc

Production of lead and zinc metal rose in 1973.

The South Mine at Broken Hill operated profitably under new management in 1973 following recommencement in late 1972; retreatment of residue dumps continued.

Black coal

There has been a significant revival in the Australian black coal industry in recent years as a result of increased exports and increased consumption of black coal in iron and steel production and electricity generation. These increases have more than balanced reduced consumption in some applications due to competition from fuel oil.

The expansion of the export trade has been of major significance. In 1955 exports were about 200,000 tonnes valued at about \$1.7 million; in 1973 exports were 28.4 million tonnes valued at \$321 million. These increased exports have been largely to Japan for use in the iron and steel industry. As a result of this increased demand, new mines have been opened and others are under development in Queensland and New South Wales, and many established mines are being expanded. Exploration for coal has been stimulated and further rich deposits of coking coal have been located, particularly in Queensland.

Petroleum

At the end of 1973 there were seven oil fields in production: Moonie, Alton and Bennett in Queensland; Barrow Island in Western Australia; and Barracouta, Halibut and Kingfish in the Gippsland Shelf area offshore from Victoria. The production of crude oil from these in 1973 amounted to 22,620,000 cubic metres representing 69 per cent of the year's total input to Australian refineries of crude oil and other feedstock of 32,879,000 cubic metres. The average daily production of 61,900 cubic metres in 1973 was 19 per cent higher than the 52,000 cubic metres daily average in 1972.

Natural gas production in 1973 amounted to 4,099 million cubic metres, 28.6 percent more than in 1972. About 10 percent of the 1973 total production was used in the field and processing plants and the balance was sold mainly as fuel to markets in Victoria, South Australia, Western Australia and Queensland.

Discoveries made in 1973 included two of oil (non-commercial) at Egret and at Dockrell in the Dampier Sub-basin of the Carnarvon Basin, on the Northwest Shelf, offshore from Western Australia, and four of natural gas, of which one is at Dockrell and the other three (Kanowana, Wolgolla and Durham Downs) are in the Cooper Basin in South Australia.

The provisional figure for metres drilled in petroleum exploration and development in Australia in 1973 was 175,694 metres, which is some 120,385 metres (about 40 percent) less than the metres drilled in the previous year. About 151,458 metres of the 1973 total was attributable to exploration drilling, of which 93,077 metres were drilled offshore. Of the 76 wells completed in 1973, 65 were exploration wells, of which 32 were offshore. In comparison with the previous year there was a decline of 34 in the number of exploration wells and 22 development wells; there was a decline of 6 in the number of offshore exploratory wells. Of the exploration wells drilled, 1 was completed as a potential oil producer and 5 as gas producers; of the development wells 10 were completed as potential gas producers.

Nickel

Output from Australia's major nickel mining operation at Kambalda in Western Australia has grown to more than 40,000 tonnes of contained nickel per annum since mining commenced in 1967. Mines at Nepean and Scotia also commenced production in early 1969 and that at Windarra will commence production in 1974; mines have been developed at Carr Boyd Rocks and, in the Widgiemooltha area, at Redcross and Location 3. At the end of 1973 the refinery at Kwinana, Western Australia, was producing more than 20,000 tonnes of nickel metal per annum from concentrates. The flash smelter commissioned at Kalgoorlie has a design capacity of 200,000 tonnes of concentrate a year. Capacity will be increased by 75 per cent when certain modifications are made. The matte produced is feed for the Kwinana refinery and overseas refineries.

Development of the lateritic nickel deposit at Greenvale in northern Queensland is proceeding. Construction of a railway and an ammonia leach treatment plant at Townsville, northern Queensland, was completed in 1974. After commissioning operations, production at the rate of 23,000 tonnes of nickel oxide sinter per annum should commence early in 1975.

Mineral sands

The history of the mineral sands industry and an assessment of resources is presented in the *Australian Mineral Industry—Quarterly Review* Vol. 25 No. 1.

Production of mineral sands at Eneabba, Western Australia, commenced on a pilot plant scale in early 1973. Rated annual capacity of the separation plant was 7,000 tonnes of rutile, 15,000 tonnes of zircon and 28,000 tonnes of ilmenite. Full-scale production at 450,000 tonnes of heavy minerals per year is planned for mid-1975. Another plant with a rated annual capacity of 240,000 tonnes of heavy minerals per year was commenced in April 1974 and shipments of rutile and ilmenite commenced in August 1974. Feasibility studies are being carried out on at least two other separate mineral sands projects in the Eneabba-Jurien Bay area, and by the late 1970s annual production of 150,000 tonnes of rutile, 289,000 tonnes of zircon and 500,000 tonnes of ilmenite could be achieved from this region. An ilmenite beneficiation plant has operated on a semi-commercial scale of about 10,000 tonnes per annum at Capel, Western Australia, since 1968. A commercial 30,000 tonnes per annum upgrading plant was commissioned at Capel in June 1974.

Phosphate

Following the increase in the world price of phosphate rock in late 1973, after a 20-year period of relatively constant prices, the development of the Duchess deposits for production in 1975 is being examined. Existing railway and port facilities can be extended, thereby enabling production from Duchess to be commenced earlier than possible from the Lady Annie-Lady Jane deposits, which require beneficiation and new transport and port facilities. The Duchess deposits contain "direct shipping" rock.