

## 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* (10.17), comprising two parts—Part 1—Quarterly Review and Part 2—Quarterly Statistics. The annual mimeographed statistical bulletins *Mining Establishments* (10.48) (replacing the former *Mining and Quarrying*), *Mineral Production* (10.51) (replacing the former *Minerals and Mineral Products*), *Mineral Exploration* (10.46), and *Overseas Participation in Australian Mining Industry* (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. 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. These deposits are the result of a long period of weathering and reworking.

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 central and northern New South Wales coast, southern Queensland and south-western Western Australia. The deposits of the eastern States are considered to be final derivatives of Mesozoic 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 former 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 4,000 to 680,000 square miles and contain marine and continental sedimentary rocks ranging in maximum thickness from 1,000 to about 30,000 feet 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, 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.

Crude oil and natural gas have been found in a number of sedimentary basins. In the Bowen-Surat Basin, Queensland, commercial deposits of oil exist at the Moonie and Alton 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. Gas reserves are present in the Adevale Basin at Gilmore, and in a dozen or so accumulations in the Cooper Basin which extends from South Australia into Queensland and the Northern Territory. In general the oil reservoir rocks in Queensland are of Lower Jurassic age, and the gas reservoir rocks are of Mesozoic and Permian age. In the Gippsland Basin, off-shore from Victoria in Bass Strait, oil in considerable quantities was discovered in the Kingfish and Halibut fields and recent indications are that the Mackerel field will also be included; oil and natural gas in the Marlin and Barracouta fields; and natural gas in the Snapper field. In the same basin, significant deposits of hydrocarbons were encountered in the Flounder, Tuna, Bream, and Emperor prospects. In the Gippsland Basin, the 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. In the Cooper Basin, South Australia, commercial deposits of natural gas were discovered at Gidgealpa and Moomba, and also at Daralingie, Toolachee, Merrimelia, Della, Strzelecki, Mudrangie, Moorari, Coonatie, Fly Lake and Big Lake, and gas and oil at Tirrawarra, Moorari and Fly Lake. The reservoir rocks are of Permian age and plans to supply Sydney and some large towns in New South Wales with gas from the Cooper Basin by 1974 are well advanced. In the Carnarvon Basin, Western Australia, commercial crude oil mainly in the Cretaceous formations, and also to a lesser degree in the Jurassic, was discovered at Barrow Island. Off-shore, on the northwest continental shelf, major gas deposits have been discovered at Scott Reef, Rankin, Goodwyn, Angel and North Rankin and oil was discovered at Rankin and Legendre, which are at present, non-commercial. Further south, in the Perth Basin, natural gas in commercially significant quantities was discovered in the Yardarino, Gingin, Dongara and Mondarra areas, the reservoir rocks being of Lower Jurassic, Lower Triassic and Permian ages. Perth is now supplied with natural gas from the Dongara and Mondarra fields and this will also be piped to the large towns. A more recent discovery is in the Walyering area. In the off-shore Bonaparte Gulf Basin high pressure natural gas was encountered at the Petrel and Tern prospects. In the Amadeus Basin, Northern Territory, natural gas was discovered in commercial quantities in formations of Ordovician age at Mereenie and Palm Valley. These are not yet being exploited but several proposals are under consideration. The gas accumulation in the Mereenie Anticline is underlain by the oil column in the same Pacoota Sandstone reservoir.

Of the non-metallic minerals, many occur in, or were formed from, rocks of various ages. The most important are asbestos, clays, sand and gravel, limestone, gypsum, and silica. Salt won by evaporation of sea water is another important product.

Opals are found in the flat-lying sedimentary beds of the Great Artesian Basin in Queensland, New South Wales and South Australia. These opal deposits were formed during the Tertiary Period.

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 in Year Book No. 53, page 1062

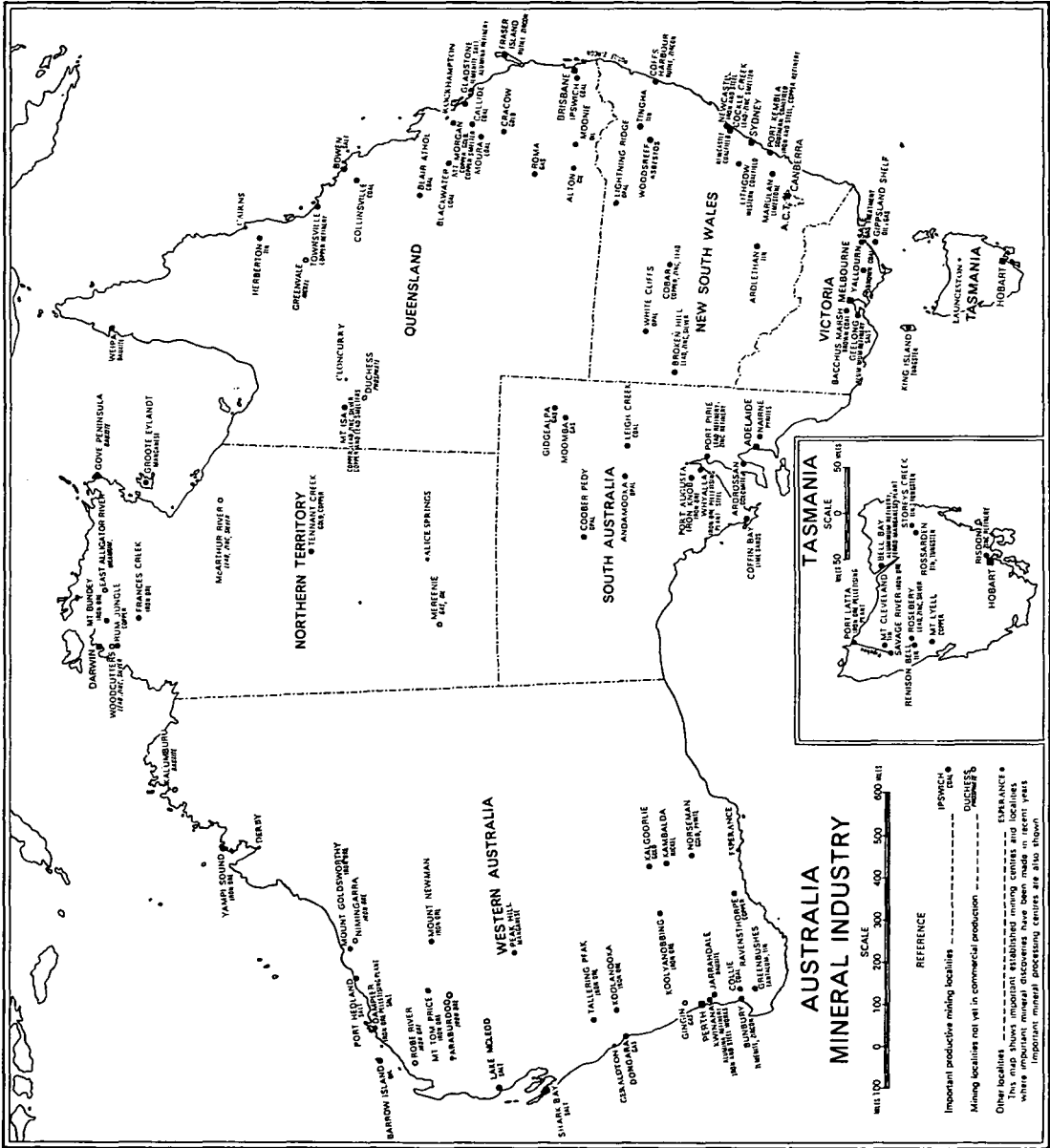


PLATE 50

### 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	Asbestos (chrysotile)	Antimony		
	Barite	Beryl		
	Bauxite	Glass sands		
	Bismuth	Talc		
	Cadmium	Tantalite		
	Coal (black)			
	Copper			
	Gold			
	Gypsum			
	Iron ore			
	Lead			
	Manganese ore (metallurgical)			
	Mineral sands(a)			
	Nickel			
	Opal			
	Salt			
	Silver			
	Tin			
	Tungsten			
	Zinc			
	Production sufficient for domestic demand	Clays (except light grade china clay)	Natural gas	
Coal (brown)		Sillimanite		
Dolomite				
Felspar				
Limestone				
Production not sufficient for domestic demand	Lithium minerals	Abrasives		
	Phosphate rock	Arsenic		
	Sulphides (as source of sulphur)	Bentonite		
		China clay		
		Chromite		
		Cobalt		
		Crude oil		
		Diatomite		
		Fluorite		
		Magnesite		
		Manganese ore (chemical)		
		Mercury		
		Mineral pigments		
Molybdenum				
Platinum				
Production nil	Magnesium	Asbestos (crocidolite)	Borates	
	Potassium salts		Nitrates	
	Vanadium	Diamonds	Sulphur	
		Graphite		
	Vermiculite			

(a) Ilmenite, monazite, rutile, zircon.

### Individual minerals

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

**Coal.** Australia has coal resources adequate to provide for future domestic requirements and a substantial export surplus. These resources include coal of all types, except pure anthracite. 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. An inventory of Australian coal resources at December 1970 was published in September 1971 by the Bureau of Mineral Resources in the *Australian Mineral Industry—Quarterly Review* vol. 23, no. 4.

**Copper.** The principal deposit of this metal is at Mount Isa, Queensland where ore reserves were estimated at 130 million tons in 1971. Other important deposits are situated at Cobar, New South Wales, Mount Morgan, Queensland, Mount Lyell, Tasmania, Kanmantoa, South Australia and Tennant Creek, Northern Territory.

**Crude oil.** Recent exploration and development activity indicates that Australia has substantial reserves of crude oil and that additional reserves may be discovered in the near future as exploration activity finds further drilling prospects, particularly in the off-shore areas. The Moonie and Alton fields in Queensland, and the Barrow Island field in Western Australia have been producing since 1964, 1966 and 1966 respectively. The Barracouta, Halibut and Kingfish fields in the off-shore Gippsland Shelf area in Victoria commenced production in 1969, 1970 and 1971 respectively. At the end of 1971, recoverable reserves in Australia were estimated to be 1,854 million barrels and the recent discoveries indicate the possibility of an upward revision of this figure in the near future.

**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 3.8 million tons in late 1970, with an average gold content of 4.19 dwt per ton.

**Iron ore.** In recent years very extensive deposits of iron ore have been discovered in Australia. These discoveries have established Australia as one of the most important iron ore provinces in the world. The largest deposits are located in the Hamersley and Ophthalmia Ranges of north-west Western Australia. Other commercially important deposits of iron ore are situated in the Savage River area of Tasmania, in the Middleback Ranges of South Australia, in the Mount Goldsworthy area, and at Yampi Sound, Koolyanobbing, and Koolanooka in Western Australia, and at Mount Bunday and Frances Creek in the Northern Territory. 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 50 per cent are estimated to be more than 20,000 million tons.

**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 are currently 16.5 million tons assaying 11 per cent lead and 11 per cent zinc. Reserves at another major producing mine, Mount Isa in Queensland, are 55 million tons assaying 7 per cent lead, 6 per cent zinc. Preparations are now being made to start production from a new mine near Mount Isa with reserves of 35.0 million tons of ore, assaying 8 per cent lead and 10 per cent zinc. The capacity of the mine at Rosebery in Tasmania (reserves of 9.1 million tons, 5 per cent lead and 16 per cent zinc) is being increased. Development of the McArthur River deposit in Northern Territory (reserves of 200 million tons, 4 per cent lead and 9 per cent zinc) is dependent on the solution of complex metallurgical problems. During 1970, a new deposit was discovered near Tarago, near Goulburn, N.S.W.; reserves are initially estimated at 7 million tons assaying 3.3 per cent lead, 9.4 per cent zinc and 2.9 per cent copper. Reserves also exist at Cobar, New South Wales, Beltana, South Australia, and Brown's Prospect and Woodcutters, Northern Territory.

**Manganese.** Australia's known reserves of manganese, which is highly important for the iron and steel industry, are in excess of domestic requirements, and exports have increased sharply in recent years. The principal deposits currently being worked are in the Pilbara area of Western Australia and on Groote Eylandt in the Gulf of Carpentaria. Reserves on Groote Eylandt are substantial and supply 78 per cent of Australian production.

*Mineral sands.* Ores of titanium (rutile and ilmenite), zirconium (zircon) and thorium (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, 170 miles 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 1970 Australia was responsible for about 90 per cent of the world's supplies of rutile, 85 per cent of zircon, 50 per cent of monazite and 25 per cent of ilmenite. With the cessation of rutile mining operations in Sierra Leone, Australia is now supplying about 98 per cent of the world requirements.

*Natural gas.* Significant discoveries of natural gas have been made throughout Australia, the most notable being the Barracouta, Marlin, and Snapper fields with combined reserves of 8.5 U.S. trillion cubic feet, at least a dozen fields in the Cooper Basin in South Australia with cumulative recoverable reserves in excess of 3 U.S. trillion cubic feet, and numerous small fields in the Roma, Surat and Rolleston areas in Queensland with combined reserves of 350 U.S. billion cubic feet. Commercial production is being undertaken from the Barracouta, Marlin, Gidgealpa, Moomba, Dongara, Mandarra and Roma fields. Total daily gas production at the end of 1971 was of the order of 238 million cubic feet. To these fields must be added the significant discoveries at Yardarino and Gingin in Western Australia. Reserves of 1.6 U.S. trillion cubic feet at Mereenie and Palm Valley in the Northern Territory are not yet being exploited. Large reserves of natural gas have been discovered on the north-west continental shelf at Petrel, Scott Reef, North Rankin, Rankin, Angel and Goodwyn. At the end of 1971, the total reserves of natural gas in Australia, excluding Papua New Guinea, were estimated at 14.1 U.S. trillion cubic feet.

*Natural gas liquids.* The production of natural gas liquids in association with natural gas is becoming an important facet of Australian petroleum production. Natural gas liquids, also known as condensate, are produced in association with gas from the Barracouta, Marlin, Gidgealpa and Moomba fields and to a lesser degree at Roma. Natural gas liquids from Barracouta and Marlin are separated from the gas at the Longford gas and crude stabilisation plant and piped to Westernport Bay for shipment to local and export markets. As yet, the liquids extracted from the Gidgealpa and Moomba gas are not used commercially. The liquids produced at Roma, because of their small quantity, are mainly used as a fuel on the producing fields. At the end of 1971, reserves of natural gas liquids in Australia, excluding Papua New Guinea, were estimated to be 300 million barrels.

*Nickel.* In the Kalgoorlie-Widgiemooltha area of Western Australia more than 21 nickel sulphide ore bodies have been found since the original discovery of nickel ores was made at Kambalda by Western Mining Corporation. Total ore reserves in the Kalgoorlie area are more than 27 million tons, averaging 3.0 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 250 million tons averaging 0.6 per cent nickel. A recent discovery in the Leonora-Wiluna area was made at Agnew where the ore body is estimated to contain at least 9 million tons of ore averaging 2 per cent nickel.

A nickel refinery has been built at Kwinana, Western Australia, with an annual capacity of 15,000 tons which is expected to be expanded to 20,000 tons. A smelter is being built at Kalgoorlie with an annual capacity of 20,000 tons of nickel metal and is expected to be in operation by 1973.

Lateritic nickel deposits have been discovered at Greenvale in Queensland where development work has started. Other large, but at present uneconomic, deposits of this type have been found 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.* Accelerated search for phosphate rock commencing in late 1964 resulted in the discovery of major deposits in north-west Queensland and in the Northern Territory with reserves exceeding 2,600 million tons. It is unlikely that these will be developed in the near future.

*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 Gibsonvale, Ardlathan 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.

*Uranium.* In 1971, following the discovery of large deposits of uranium ore in the Northern Territory, the Minister for National Development announced that the Government would maintain a system of control of exports of uranium from Australia which would not involve quantitative restrictions for the present. A close watch would be kept on proven reserves and the amount exported

to ensure that adequate supplies are retained for future requirements. Appropriate safeguards to ensure that the exported materials are used for peaceful purposes only, is mandatory. Mary Kathleen Uranium Ltd has contracts to export 3,800 tons to be delivered between 1975 and 1981. The mine at Rum Jungle has now closed down. During 1970, three large deposits were discovered in the East Alligator River area of the Northern Territory. Preliminary estimates suggest that two of the deposits could each contain more than the total of previously known uranium reserves in Australia. Further work is being carried out at Nabarlek, Jim Jim and Ranger 1; preliminary estimates suggest that at least 100,000 short tons of uranium oxide will be proven in these deposits. Discovery of a large deposit near Wiluna, Western Australia was announced in 1971 but reserves have not been determined. Other important areas of exploration are Mount Painter and Lake Frome in South Australia, South Alligator River in the Northern Territory and the Westmoreland and Mount Isa areas of Queensland.

### Administration

For all practical purposes all mineral rights in Australia are vested in the Crown. In the States, sovereign rights are held by the State Governments with respect to mineral resources within their boundaries. In the Territories of the Commonwealth these rights are vested in the Commonwealth Government. The Commonwealth 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 in the Commonwealth has its own mining Acts or Ordinances and regulations governing the prospecting for and working of mineral deposits. These Acts, etc. are similar in principle, but differ in detail. They all make provision for miners' 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 have been enacted to modernise the legislation, it is 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).

In January 1971 a Committee of Enquiry reported to the Western Australian Government on means of bringing the *Mining Act*, 1904 up to date. In April 1971 the Premier announced that the Western Australian Government intended to implement the recommendations of the Committee of Enquiry. A new Mining Bill has been introduced into Parliament but, at May 1972, had not been passed. The Queensland Parliament passed a new Mining Act in 1968 which was simpler but more suited to modern conditions than the *Mining Act* 1897 to 1967. The 1968 Act became operative on 1 January 1972. A new Mining Act for the same purpose was passed by the South Australian Parliament on 9 December 1971 but has not yet come into operation.

AREAS OCCUPIED UNDER MINING ACTS AND ORDINANCES(a)  
STATES AND NORTHERN TERRITORY, 31 DECEMBER 1967 TO 1971  
(<sup>'000 acres</sup>)

Year	N.S.W.(b)	Vic.	Qld(c)	S.A.(b)	W.A.	Tas.	N.T.(b)	Total
1967 . .	1,177	74	2,304	98	372	60	37	4,121
1968 . .	1,146	61.5	2,618	99	705	66	43	5,290
1969 . .	1,397	626	2,607	97	1,471	54	93	6,345
1970 . .	1,495	2,319	3,568	121	5,512	60	97	13,172
1971 . .	1,148	1,249	3,926	130	7,820	62	46	14,381

(a) Excludes areas held under special arrangements; see following text. (b) At 30 June. (c) Excludes lands held under miners' rights and dredging claims.

### 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 1967-1968* 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 Federal 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 Federal 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 903. For full details of the off-shore legislation, see Year Book No. 55, pages 997-8.

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

**AREAS OCCUPIED UNDER PETROLEUM EXPLORATION AND DEVELOPMENT  
TITLES: STATES AND NORTHERN TERRITORY, 31 DECEMBER 1970 AND 1971**  
(<sup>0</sup>000 acres)

Year	N.S.W.	Vic.	Qld	S.A.(a)	W.A.	Tas.	N.T.(a)	Total
<b>ON-SHORE AREAS (square miles)</b>								
1970 . .	87,886	253,080	506,118	233,526	n.a.(b)	639	61,769	n.a.
1971 . .	75,732	184,910	397,484	219,966	n.a.(b)	230	577,434	n.a.
<b>OFF-SHORE AREAS (5 minute blocks) (c)</b>								
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

(a) At 30 June. (b) Available only in terms of 5 minute blocks of which there were 5,517 at 31 December 1970 and 6,510 at 31 December 1971. (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 ton (e.g. 5c per ton 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, 1966-67 TO 1970-71**  
(*\$'000*)

	1966-67	1967-68	1968-69	1969-70	1970-71
New South Wales(a)	16,807	11,685	9,795	13,558	17,819
Victoria(b)	598	663	(c)687	(c)2,736	(c)12,239
Queensland(a)	2,355	1,844	1,688	3,039	5,483
South Australia	1,092	1,037	1,254	1,557	1,798
Western Australia	2,640	6,238	11,001	15,700	22,347
Tasmania(d)	87	87	(e)251	(e)424	(e)410
Northern Territory	111	291	283	449	431
Commonwealth	10	9	(c)11	492	(c)5,024
<b>Total</b>	<b>23,699</b>	<b>21,853</b>	<b>24,971</b>	<b>37,953</b>	<b>65,552</b>

(a) Includes royalty on sand and gravel from Crown lands. (b) Includes royalty on brown coal paid by State Electricity Commission. (c) From 1968-69 includes royalties received under the *Petroleum (Submerged Lands) Act*, 1967-68. (d) Includes rent and fees from mineral lands. (e) From 1968-69 includes royalties on iron ore.

**Control of exports**

The Commonwealth Government maintains export controls over certain minerals and metals. These controls are enforced by means of Customs (Prohibited Exports) Regulations as amended from time to time by Statutory Rules. The Commonwealth authorities having jurisdiction over mineral and metal exports, together with the relevant products, are listed below. A clearance to export is needed in each case.

*Department of National Development*—iron ores, beneficiated iron ores and iron concentrates; mineral sands (whether treated or untreated), and concentrates of mineral sands, containing zircon, rutile or ilmenite; manganese ores; beryllium ores and concentrates; tin ores and concentrates, refined tin in the form of ingots or in any other refinery form, and any of the following materials from which tin may be obtained, being materials resulting from the refining of tin, that is to say residues, slag, dross, dust and other wastes; copper matte, blister copper, copper scrap, copper refinery shapes; copper alloys in the form of ingots, billets, etc.; copper alloy scrap; any of the following materials from which copper may be obtained, that is to say, residues, speiss, slag, dross, scale sweepings, ash, sludge, slime, dust and wastes; and natural gas.

The Minister for National Development announced on 20 January 1970 that the export of natural gas would be subject to control in order to conserve supplies for local use. Export will be permitted only from fields remote from significant local markets. On 24 February 1971 the Ministers for National Development and Customs and Excise announced the introduction of minimum export price controls for zircon.

*Department of Primary Industry*—phosphate rock, phosphate and superphosphate, and fertilisers containing phosphate or superphosphate.

*Australian Atomic Energy Commission*—minerals, raw and treated (including residues and tailings) containing more than 0.05 per cent of uranium or thorium, singly or together; uranium and thorium minerals including pitchblende and monazite; uranium, thorium, beryllium and lithium metals, compounds and alloys; hafnium-free zirconium metal, alloys and compounds; nickel metal in certain forms.

### Joint Coal Board

The Joint Coal Board was established in 1946 under joint legislation of the Commonwealth 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.

### Australian Atomic Energy Commission

During 1953, Commonwealth 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 National Development.

## Government assistance

The Commonwealth 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.

### Commonwealth Government Assistance

Assistance provided by the Commonwealth 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 Commonwealth Government payments to sectors of the mineral industry is included on page 907.

*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.

Dividends paid wholly and exclusively out of exempt mining income are also exempt from tax.

One third of call moneys paid by resident and non-resident investors on non-redeemable shares in a company, whose principal business is mining or prospecting for minerals in Australia or Papua New Guinea, is allowable as a deduction from the investors' assessable income. Where the shares in such a company are issued after 9 May 1968, the deduction is dependent upon the company lodging a declaration that the call moneys have been, or will be, expended exclusively on the search for minerals (including petroleum) obtainable by mining.

Other valuable assistance has been given in the form of certain taxation concessions to encourage the search for petroleum and other minerals. Resident investors are permitted, for tax purposes, to deduct from their assessable income all application, allotment and call moneys paid for shares issued by petroleum exploration companies or companies engaged in prospecting or mining for other minerals obtainable by mining. These deductions are allowable only if the company elects to forgo

an equivalent amount of the special deductions for capital expenditure to which it would otherwise be entitled. Many companies engaged in exploring for petroleum and other minerals have elected to pass on this benefit to their shareholders.

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. Dividends paid wholly and exclusively out of profits so freed from tax are exempt.

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.* In 1957 the Commonwealth Government introduced the *Petroleum Search Subsidy Act 1957* whereby stratigraphic drilling operations were subsidised to the extent of 50 per cent of cost. An amendment in 1959 widened the scope of operations for which subsidy was offered to include all types of geophysical surveys and off-structure drilling. Subsidy payments under the Act for the years 1967 to 1971 are shown in the table on page 907.

Various amendments to the Act and Regulations have altered the amount of subsidy and the type of operations to which a subsidy is applicable. The most recent amendment in 1969, provided for the payment of subsidy for approved operations completed before 30 June 1974. On-shore exploration drilling is subsidised at the rate of 30 per cent of approved costs and on-shore geophysical operations at a rate of 50 per cent. All similar off-shore operations are subsidised at a rate dependent upon the Australian financial contribution to the operation, the maximum rate being 30 per cent for operations wholly financed by Australian companies. Details of earlier amendments are given on page 1001 of Year Book No. 55.

*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 Commonwealth 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 to apply 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 will be based on the importer's share of total imports of refinery feedstock or refined products or both.

Any oil found in Papua New Guinea will be covered by these policies in the same way as oil found in Australia.

Under these arrangements the price of Moonie crude is \$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 Commonwealth Government the Gippsland Shelf operators agreed to forgo the \$0.67 a barrel incentive, plus a further \$0.05 per barrel. This applied 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 new pricing structure is also for a 5 year period.

Under this agreement the Gippsland crude oil will be 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
	<hr/>
	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
	<hr/>
	1.89
less a deduction for coastal freight . . . . .	0.09
	<hr/>
	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 will be \$2.15 per barrel f.o.b. Brisbane, since the coastal freight deduction of 9 cents per barrel does not apply.

Barrow Island crude will be 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 as it now stands the subsidy payable to small producers whose annual deliveries do not exceed 500 fine oz is \$6 per fine oz, irrespective of cost of production. For large producers, subject to certain provisions, the rate of subsidy payable is 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 exceed 500 fine oz may elect to be treated

as a small producer. In this case the subsidy rate payable per fine oz on total deliveries is \$6 reduced by 1c for each fine oz by which deliveries exceed 500 fine oz. The benefit under this provision terminates when deliveries in a year reach 1,100 fine oz. Where a producer receives an amount in excess of the official price of \$31.25 per fine oz as a result of sales on overseas premium markets or otherwise, the subsidy payable is, with effect from 1 January 1972, reduced by fifty per cent of the amount of the excess. Prior to 1 January 1972 subsidy was reduced by seventy-five per cent of the excess.

Payments under the Act will apply to production until 30 June 1973. The amounts paid to gold producers in the various States and Territories of Australia in each of the years 1967 to 1971 are shown in the table below.

*Assistance to the producers of sulphuric acid and iron pyrites.* Following recommendations of the Tariff Board, the *Sulphuric Acid Bounty Act 1954-1971* and the *Pyrites Bounty Act 1960-1971* were extended to 31 May 1972. The Acts provide for payment of bounty on sulphuric acid produced from prescribed Australian materials, and to producers of iron pyrites. Payments under these Acts for the years 1967 to 1971 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 \$12 per ton. Outside this range, bounty is payable at \$60 per ton 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, for the years 1967 to 1971, are set out in the following table.

**COMMONWEALTH GOVERNMENT PAYMENTS TO THE MINERAL  
INDUSTRY: AUSTRALIA, 1967 TO 1971**  
((\$'000))

Year	<i>Petroleum exploration (a)</i>	<i>Gold mining(b)</i>	<i>Pyrites mining(c)</i>	<i>Sulphuric acid production (d)</i>	<i>Phosphate fertiliser production (e)</i>
1967 . . .	10,327	3,859	46	1,382	25,544
1968 . . .	13,805	2,817	..	1,279	24,907
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

(a) *Petroleum Search Subsidy Act 1959-69.* Includes payments in Papua New Guinea; see also the table on page 931. (b) *Gold-Mining Industry Assistance Act 1954-72.* Includes payments in Papua New Guinea. (c) *Pyrites Bounty Act 1960-1971.* (d) *Sulphuric Acid Bounty Act 1954-1971.* (e) *Phosphate Fertilisers Bounty Act 1963-1971.*

*Bureau of Mineral Resources, Geology and Geophysics.* The functions of the Bureau 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 Commonwealth 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 the Commonwealth 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.

The Bureau comprises five branches under the Director: Operations, Mineral Resources, Geological, Geophysical, and Petroleum Exploration. The Operations Branch consists of three sections, Planning and Co-ordination, Publications and Information, and Administrative. It carries out central office functions, including planning and control of programme, assessment of results, co-ordination of activities, liaison, and distribution of information. The Mineral Resources Branch comprises the sections Mineral Economics, Mining Engineering, and Petroleum Technology, and is concerned largely with those aspects of the Bureau'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 the Bureau, and the operation of observatories, while the Petroleum Exploration Branch is concerned with the administration of the *Petroleum Search Subsidy Act 1959-1969* and is also engaged in the assessment of sedimentary basins in Australia and its Territories. The establishment of the Bureau is 627 officers (at 30 June 1971), of whom 308 were professional. The budget for the financial year 1971-72 was \$17.3 million, of which \$8.6 million was provided for payment under the *Petroleum Search Subsidy Act 1959-1969*.

The Bureau 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. The Bureau also maintains a vulcanological observatory at Rabaul and 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.

*Commonwealth Scientific and Industrial Research Organization.* The activities of this body with respect to the mineral industry are discussed on page 908 under Research.

#### 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, which are repayable in the event of pay minerals being discovered, are made to cover half the cost of prospecting and drilling operations. Loans 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 programme 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 1970-71 amounted to \$944,631 including \$617,589 on the Department's own drilling programme.

*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, 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. 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, guidance on mining legislation, 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. The Government also has a drilling scheme, financing mine-owners on a \$1 for \$1 basis.

*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 Northern Territory Administration 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 Northern Territory Administration 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.

### 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. Research conducted by the Commission is discussed in detail in Year Book No. 55, page 561.

### 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 Commonwealth 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.

### **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 911). 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.

Initial emphasis is being 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; mobility of sulphides under the influence of temperature and pressure and the interaction of mineral types; and biological leaching of low-grade sulphide minerals.

### **Bureau of Mineral Resources, Geology and Geophysics**

Mineral research by the Bureau of Mineral Resources is concerned with basic problems of mineral emplacement. Special studies are undertaken of: the sedimentary environment of potentially oil-bearing rocks; the genesis of continental and marine phosphate; the fundamental chemistry of metallic ore deposits; the structural, chemical, and stratigraphic contents of ore deposits; and geo-physical interpretation by means of model testing.

For details of the functions of the Bureau of Mineral Resources, Geology and Geophysics, *see* page 907.

### **Commonwealth Scientific and Industrial Research Organization**

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

- (a) *Exploration*. To improve and develop procedures for locating mineral deposits (surface geochemistry, rock geochemistry, structural analysis, geobiology, remote sensing).
- (b) *Mineralisation*. To improve methods of recognizing and defining the nature and economic significance of specific types of mineralisation (nickel, chromium, acid igneous deposits, stratiform ores, ore-forming fluids, electromagnetic geophysics, field analysis, mineral structures).
- (c) *Mining and concentration*. To identify, and utilize in practice, those properties of minerals and rocks which will increase the overall efficiency of their mining, concentration and handling (mineral dressing, flotation chemistry, reactivity, non-metallics).
- (d) *Process Metallurgy*. To improve and develop methods for the economic processing of minerals and mineral products (slags, sulphide electrolysis, iron ore, nickel ores, ilmenite, copper, tin, zinc, lead, structures and bonding, plasmas).
- (e) *Fuels*. To improve and develop methods for exploiting fossil fuels (deposits, electrode carbon, combustion, gas cleaning).
- (f) *Associated industries*. To apply the skills and expertise of the Mineral Research Laboratories to the improvement and development of industrial processes not necessarily connected with the minerals industry (polymers, pulp and paper, sugar, chemicals, dairy).

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 functions of the National Coal Research Advisory Committee are to review coal research activity in Australia, to recommend priorities for further activities in this area, and to allocate special Commonwealth funds of \$260,000 per year provided for coal research projects as recommended by the committee. This amount is additional to that expended by C.S.I.R.O. and Commonwealth Departments on coal research. The major beneficiary under this scheme is the Australian Coal Industry Research Laboratories; other beneficiaries have been the State Electricity Commission of



Victoria (for brown coal research) and the Universities. From 1965 to 1969 special coal research funds of \$520,000 annually were available to the committee, comprising the Commonwealth contribution of \$260,000 matching an equivalent total contribution from State Governments and coal producing and consuming industries. Beginning with the financial year 1968-69 the States and industry are independently sponsoring coal research and development according to their own individual requirements.

#### 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 1971 was: full members 59, associate members 18, registered divisions 13. This represented a large proportion of the mining, metallurgical and related companies operating in Australia at that time. Expenditure on research projects during the year 1970-71 was \$367,840.

### 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 Commonwealth 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 tons 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, Spain, 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 tonnages 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.

#### **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 a more complete picture of the place of the mining industry and other associated activities in the Australian economy.

#### **Mining industry statistics, 1968-69 and 1969-70**

This section contains statistics of the mining industry for all States and Territories and Australia obtained from Mining Censuses taken in respect of the years ended June 1969 and 1970.

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 1969-70 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 statistics in this sub-section are subject to revision. The table below shows key items of data for Australia for 1968-69 and 1969-70. Each following table shows statistics for a particular item for all States and Territories and Australia for 1968-69 and 1969-70 and is preceded by an explanation of the item.

MINING ESTABLISHMENTS: SUMMARY OF OPERATIONS, BY INDUSTRY SUB-DIVISION  
AUSTRALIA, 1968-69 AND 1969-70

Industry sub-division	Number of establishments operating during year		Persons employed(b)			Wages and salaries \$'000	Turn-over \$'000	Stocks at 30 June		Purchases, transfers in and selected expenses \$'000	Fixed capital expenditure (outlay on fixed tangible assets less disposals)	
	ASIC code(a)		Males	Females	Total			Opening	Closing		Value added	
	No.	No.	No.	No.	No.	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	
1968-69												
Metallic minerals . . . . .	11	339	25,428	1,243	26,671	115,156	639,872	59,028	72,600	223,861	429,583	130,030
Coal . . . . .	12	151	19,512	321	19,833	94,909	343,942	26,630	27,344	135,093	209,563	151,605
Crude petroleum including natural gas . . . . .	13	7										
Construction materials . . . . .	14	843	6,284	408	6,692	23,307	120,928	9,163	10,039	45,978	75,827	10,290
Other non-metallic minerals . . . . .	15	345	1,950	79	2,029	6,349	36,556	2,950	3,385	16,155	20,836	10,971
Total mining, excluding services to mining . . . . .		1,685	53,174	2,051	55,225	239,720	1,141,299	97,771	113,367	421,087	735,809	302,905
1969-70p												
Metallic minerals . . . . .	11	369	27,420	1,462	28,882	138,156	867,948	73,239	85,609	245,418	634,900	164,040
Coal . . . . .	12	145	20,390	351	20,741	102,048	480,478	27,152	35,344	174,258	314,410	154,407
Crude petroleum including natural gas . . . . .	13	8										
Construction materials . . . . .	14	864	6,364	439	6,803	25,143	131,957	10,648	12,418	51,780	81,950	15,419
Other non-metallic minerals . . . . .	15	381	2,129	106	2,235	8,064	45,673	3,801	4,844	23,098	23,618	12,728
Total mining, excluding services to mining . . . . .		1,767	56,303	2,358	58,661	273,410	1,526,055	114,840	138,215	494,554	1,054,878	346,593

(a) Australian Standard Industrial Classification. (b) At 30 June; includes working proprietors.

Number of establishments

The following table shows the number of establishments which operated during the years 1968-69 and 1969-70. 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 DURING  
1968-69 AND 1969-70, BY INDUSTRY SUB-DIVISION, STATES AND TERRITORIES

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
1968-69										
Metallic minerals . . . . .	11	79	10	112	5	77	40	16	..	339
Coal . . . . .	12	99	5	40	1	3	3	..	..	151
Crude petroleum including natural gas . . . . .	13	..	2	4	..	1	..	..	..	7
Construction materials . . . . .	14	320	199	140	97	45	30	5	7	843
Other non-metallic minerals . . . . .	15	163	51	29	59	33	10	..	..	345
Total mining, excluding services to mining . . . . .		661	267	325	162	159	83	21	7	1,685
1969-70p										
Metallic minerals . . . . .	11	109	6	110	11	72	41	20	..	369
Coal . . . . .	12	103	5	30	1	3	3	..	..	145
Crude petroleum including natural gas . . . . .	13	..	2	4	1	1	..	..	..	8
Construction materials . . . . .	14	337	180	145	103	55	29	7	8	864
Other non-metallic minerals . . . . .	15	207	39	34	58	34	9	..	..	381
Total mining, excluding services to mining . . . . .		756	232	323	174	165	82	27	8	1,767

(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<sup>(a)</sup>  
BY INDUSTRY SUB-DIVISION, STATES AND TERRITORIES, AT 30 JUNE 1969 AND 1970**

Industry sub-division	ASIC code(b)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
<b>MALES EMPLOYED</b>										
1969										
Metallic minerals . . . . .	11	6,928	3,074	6,277 2,289	812	6,620 676	3,642 (c)	1,186	..	25,428
Coal . . . . .	12	13,355								
Crude petroleum including natural gas . . . . .	13	..	1,774	1,042 (c)	614	357	174	47	86	6,284
Construction materials . . . . .	14	2,172								
Other non-metallic minerals . . . . .	15	609	244	(c)	442	339	(c)	..	..	1,950
<b>Total mining, excluding services to mining . . . . .</b>		<b>23,064</b>	<b>5,092</b>	<b>9,889</b>	<b>1,868</b>	<b>8,010</b>	<b>3,932</b>	<b>1,233</b>	<b>86</b>	<b>53,174</b>
1970p										
Metallic minerals . . . . .	11	7,331	3,296	6,925 2,285	888	7,158 707	3,850 (c)	1,323	..	27,420
Coal . . . . .	12	13,956								
Crude petroleum including natural gas . . . . .	13	..	1,766	1,159 (c)	624	424	158	68	64	6,364
Construction materials . . . . .	14	2,101								
Other non-metallic minerals . . . . .	15	721	229	(c)	412	410	(c)	..	..	2,129
<b>Total mining, excluding services to mining . . . . .</b>		<b>24,109</b>	<b>5,291</b>	<b>10,694</b>	<b>1,924</b>	<b>8,699</b>	<b>4,131</b>	<b>1,391</b>	<b>64</b>	<b>56,303</b>
<b>FEMALES EMPLOYED</b>										
1969										
Metallic minerals . . . . .	11	238	159	425 61	55	261 12	136 (c)	47	..	1,243
Coal . . . . .	12	168								
Crude petroleum including natural gas . . . . .	13	..	156	66 (c)	26	16	3	1	10	408
Construction materials . . . . .	14	130								
Other non-metallic minerals . . . . .	15	28	10	(c)	15	16	(c)	..	..	79
<b>Total mining, excluding services to mining . . . . .</b>		<b>564</b>	<b>325</b>	<b>558</b>	<b>96</b>	<b>305</b>	<b>145</b>	<b>48</b>	<b>10</b>	<b>2,051</b>
1970p										
Metallic minerals . . . . .	11	283	163	502 43	83	308 13	164 (c)	50	..	1,462
Coal . . . . .	12	199								
Crude petroleum including natural gas . . . . .	13	..	157	79 (c)	24	50	2	5	1	439
Construction materials . . . . .	14	121								
Other non-metallic minerals . . . . .	15	56	9	(c)	15	15	(c)	..	..	106
<b>Total mining, excluding services to mining . . . . .</b>		<b>659</b>	<b>329</b>	<b>634</b>	<b>122</b>	<b>386</b>	<b>172</b>	<b>55</b>	<b>1</b>	<b>2,358</b>

(a) At 30 June; includes working proprietors.  
for publication.

(b) Australian Standard Industrial Classification.

(c) Not available

**MINING ESTABLISHMENTS: MALES, FEMALES AND PERSONS EMPLOYED(a)  
BY INDUSTRY SUB-DIVISION, STATES AND TERRITORIES AT 30 JUNE  
1969 AND 1970—continued**

Industry sub-division	ASIC code(b)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
<b>PERSONS EMPLOYED</b>										
<b>1969</b>										
Metallic minerals	11	7,166	3,233	6,702	867	6,881	3,778	1,233	..	26,671
Coal	12	13,523								
Crude petroleum including natural gas	13	..	1,930	1,108	640	391	177	48	96	6,692
Construction materials	14	2,302								
Other non-metallic minerals	15	637	254	(c)	457	355	(c)	..	..	2,029
<b>Total mining, excluding services to mining</b>		<b>23,628</b>	<b>5,417</b>	<b>10,447</b>	<b>1,964</b>	<b>8,315</b>	<b>4,077</b>	<b>1,281</b>	<b>96</b>	<b>55,225</b>
<b>1970 P</b>										
Metallic minerals	11	7,614	3,459	7,427	971	7,466	4,014	1,373	..	28,882
Coal	12	14,155								
Crude petroleum including natural gas	13	..	1,923	1,238	648	474	160	73	65	6,803
Construction materials	14	2,222								
Other non-metallic minerals	15	777	238	(c)	427	425	(c)	..	..	2,235
<b>Total mining, excluding services to mining</b>		<b>24,768</b>	<b>5,620</b>	<b>11,328</b>	<b>2,046</b>	<b>9,085</b>	<b>4,303</b>	<b>1,446</b>	<b>65</b>	<b>58,661</b>

(a) At 30 June; includes working proprietors. (b) Australian Standard Industrial Classification. (c) Not available for publication.

**Accidents in mining**

Particulars of numbers 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. In 1969-70 (calendar year 1969 for Queensland), 79 persons were recorded as killed and 2,283 as injured in mining (including quarrying) accidents. Recorded deaths and injuries in that year in the metallic minerals industry were 21 and 679, and in the coal mining industry 20 and 343.

**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  
STATES AND TERRITORIES, 1968-69 AND 1969-70  
(\$'000)**

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
<b>1968-69</b>										
Metallic minerals	11	32,622	14,879	31,807	3,563	23,749	16,281	6,387	..	115,156
Coal	15	65,824								
Crude petroleum including natural gas	13	..	7,162	3,314	1,894	1,780	548	240	360	23,307
Construction materials	14	8,009								
Other non-metallic minerals	15	1,832	799	(b)	1,472	990	(b)	..	..	6,349
<b>Total mining, excluding services to mining</b>		<b>108,287</b>	<b>22,840</b>	<b>48,181</b>	<b>6,929</b>	<b>29,279</b>	<b>17,217</b>	<b>6,626</b>	<b>360</b>	<b>239,720</b>
<b>1969-70 P</b>										
Metallic minerals	11	36,653	14,916	37,478	3,748	34,764	17,531	7,614	..	138,156
Coal	12	71,582								
Crude petroleum including natural gas	13	..	7,680	3,171	2,094	2,229	527	403	397	25,143
Construction materials	14	8,642								
Other non-metallic minerals	15	2,559	809	(b)	1,520	1,691	(b)	..	..	8,064
<b>Total mining, excluding services to mining</b>		<b>119,436</b>	<b>23,405</b>	<b>54,770</b>	<b>7,362</b>	<b>41,497</b>	<b>18,527</b>	<b>8,017</b>	<b>397</b>	<b>273,410</b>

(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  
STATES AND TERRITORIES, 1968-69 AND 1969-70**  
(\$'000)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
1968-69p										
Metallic minerals	11	134,243	47,889	{ 147,436	58,456	{ 212,184	58,888	34,726	..	639,872
Coal	12	186,919		{ 34,789		{ 40,022				
Crude petroleum including natural gas	13	..	{ (b)	{ ..	{ ..	{ ..	{ ..	{ ..	{ ..	{ 343,942
Construction materials	14	39,867	39,969	{ 13,993	9,180	11,501	3,212	1,566	1,641	120,928
Other non-metallic minerals	15	10,155	4,873	{ (b)	13,548	2,897	(b)	..	..	36,556
<b>Total mining, excluding services to mining</b>		<b>371,184</b>	<b>92,730</b>	<b>228,590</b>	<b>81,184</b>	<b>266,604</b>	<b>63,073</b>	<b>36,292</b>	<b>1,641</b>	<b>1,141,299</b>
1969-70										
Metallic minerals	11	165,075	199,959	{ 198,144	66,846	{ 327,808	80,302	36,494	..	867,948
Coal	12	218,888		{ 74,408		{ 53,408				
Crude petroleum including natural gas	13	..	{ (b)	{ ..	{ ..	{ ..	{ ..	{ ..	{ ..	{ 480,478
Construction materials	14	46,467	43,512	{ 14,077	10,650	10,452	2,775	2,046	1,978	131,957
Other non-metallic minerals	15	13,859	4,521	{ (b)	14,518	5,990	(b)	..	..	45,673
<b>Total mining, excluding services to mining</b>		<b>444,289</b>	<b>167,992</b>	<b>299,331</b>	<b>92,014</b>	<b>397,658</b>	<b>84,253</b>	<b>38,540</b>	<b>1,978</b>	<b>1,526,055</b>

(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, STATES AND TERRITORIES, 1968-69 AND 1969-70**  
(\$'000)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
1968-69p										
Metallic minerals	11	46,576	20,325	{ 49,613	17,176	{ 80,908	18,638	14,063	..	223,861
Coal	12	82,185		{ 23,572		{ 3,430				
Crude petroleum including natural gas	13	..	{ (b)	{ ..	{ ..	{ ..	{ ..	{ ..	{ ..	{ 135,093
Construction materials	14	13,615	16,520	{ 5,400	3,024	4,796	1,194	764	665	45,978
Other non-metallic minerals	15	4,791	1,625	{ (b)	6,042	1,733	(b)	..	..	16,155
<b>Total mining, excluding services to mining</b>		<b>147,166</b>	<b>38,469</b>	<b>82,723</b>	<b>26,242</b>	<b>90,867</b>	<b>20,128</b>	<b>14,827</b>	<b>665</b>	<b>421,087</b>
1969-70p										
Metallic minerals	11	44,350	46,627	{ 40,741	19,436	{ 112,950	19,144	12,184	..	245,418
Coal	12	89,502		{ 29,100		{ 3,031				
Crude petroleum including natural gas	13	..	{ (b)	{ ..	{ ..	{ ..	{ ..	{ ..	{ ..	{ 174,258
Construction materials	14	14,993	18,422	{ 5,704	4,222	5,428	1,289	1,023	699	51,780
Other non-metallic minerals	15	7,198	2,071	{ (b)	7,122	3,703	(b)	..	..	23,098
<b>Total mining, excluding services to mining</b>		<b>156,043</b>	<b>67,120</b>	<b>80,789</b>	<b>30,770</b>	<b>125,112</b>	<b>20,814</b>	<b>13,207</b>	<b>699</b>	<b>494,554</b>

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

## Stocks

Statistics on the value of stocks at 30 June 1969 and 1970, 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: STOCKS AT 30 JUNE 1969 AND 1970  
BY INDUSTRY SUB-DIVISION, STATES AND TERRITORIES  
(\$'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 AT 30 JUNE 1969											
Metallic minerals . . . . .	11	21,551	7,048	11,462	1,592	23,993	9,121	5,054	..	..	72,600
Coal . . . . .	12	11,676									
Crude petroleum including natural gas . . . . .	13	..	(b)	(b)	..	..	..	..	..	..	27,344
Construction materials . . . . .	14	3,701	2,242	1,193	766	1,711	306	43	78	..	10,039
Other non-metallic minerals . . . . .	15	419	424	(b)	1,249	255	(b)	..	..	..	3,385
<b>Total mining, excluding services to mining . . . . .</b>		<b>37,347</b>	<b>9,713</b>	<b>19,733</b>	<b>3,607</b>	<b>28,343</b>	<b>9,450</b>	<b>5,097</b>	<b>78</b>	<b>..</b>	<b>113,367</b>
CLOSING STOCKS AT 30 JUNE 1970p											
Metallic minerals . . . . .	11	20,923	9,332	13,427	1,927	33,381	11,161	5,018	..	..	85,609
Coal . . . . .	12	17,117									
Crude petroleum including natural gas . . . . .	13	..	(b)	(b)	..	..	..	..	..	..	35,344
Construction materials . . . . .	14	4,227	2,441	1,621	811	2,701	259	180	178	..	12,418
Other non-metallic minerals . . . . .	15	524	491	(b)	1,730	1,387	(b)	..	..	..	4,844
<b>Total mining, excluding services to mining . . . . .</b>		<b>42,791</b>	<b>12,264</b>	<b>22,757</b>	<b>4 468</b>	<b>39,093</b>	<b>11,466</b>	<b>5,198</b>	<b>178</b>	<b>..</b>	<b>138,215</b>

(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  
STATES AND TERRITORIES, 1968-69 AND 1969-70  
(\$'000)

Industry sub-division	ASIC code (a)										
		N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.	
1968-69											
Metallic minerals . . . . .	11	88,535	25,773	100,241	42,009	138,838	41,524	21,406	..	..	429,583
Coal . . . . .	12	106,987									
Crude petroleum including natural gas . . . . .	13	..	(b)	(b)	..	..	..	..	..	..	209,563
Construction materials . . . . .	14	26,829	22,566	8,789	6,053	7,744	2,076	794	976	..	75,827
Other non-metallic minerals . . . . .	15	5,401	3,289	(b)	7,412	1,285	(b)	..	..	..	20,836
<b>Total mining, excluding services to mining . . . . .</b>		<b>227,752</b>	<b>51,628</b>	<b>148,978</b>	<b>55,473</b>	<b>184,516</b>	<b>44,286</b>	<b>22,200</b>	<b>976</b>	<b>..</b>	<b>735,809</b>
1969-70p											
Metallic minerals . . . . .	11	120,292	75,552	159,445	47,300	222,992	63,586	24,739	..	..	634,900
Coal . . . . .	12	134,767									
Crude petroleum including natural gas . . . . .	13	..	(b)	(b)	..	..	..	..	..	..	314,410
Construction materials . . . . .	14	31,857	25,229	8,564	6,563	5,748	1,484	1,124	1,386	..	81,950
Other non-metallic minerals . . . . .	15	6,771	2,495	(b)	7,676	3,075	(b)	..	..	..	23,618
<b>Total mining, excluding services to mining . . . . .</b>		<b>293,687</b>	<b>103,276</b>	<b>221,842</b>	<b>61,539</b>	<b>281,402</b>	<b>65,888</b>	<b>25,863</b>	<b>1,386</b>	<b>..</b>	<b>1,054,878</b>

(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, STATES AND TERRITORIES  
1968-69 AND 1969-70**

(\$'000)

<i>Industry sub-division</i>	<i>ASIC code(a)</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>
1968-69										
Metallic minerals . . .	11	15,136	100,651	22,912 13,229	6,812	68,019	12,342 (b)	10,503	..	130,030
Coal . . .	12	25,535								
Crude petroleum including natural gas . . .	13	..	2,428 736	(b) 1,009	711 264	2,196 7,578	271 (b)	116	51	151,615
Construction materials . . .	14	3,507								
Other non-metallic minerals . . .	15	678	..	(b)	..	..	..	..	..	10,290
<b>Total mining, excluding services to mining . . .</b>		<b>44,857</b>	<b>103,816</b>	<b>38,808</b>	<b>7,786</b>	<b>84,060</b>	<b>12,910</b>	<b>10,618</b>	<b>51</b>	<b>302,905</b>
1969-70 P										
Metallic minerals . . .	11	18,074	89,533	36,146 15,248	10,705	73,985	20,091 (b)	13,117	..	164,040
Coal . . .	12	33,054								
Crude petroleum including natural gas . . .	13	..	2,813 1,017	(b) 1,396	1,046 559	1,577 8,737	362 (b)	538	175	154,407
Construction materials . . .	14	7,513								
Other non-metallic minerals . . .	15	1,404	..	(b)	..	..	..	..	..	15,419
<b>Total mining, excluding services to mining . . .</b>		<b>60,044</b>	<b>93,361</b>	<b>53,707</b>	<b>12,311</b>	<b>92,711</b>	<b>20,597</b>	<b>13,655</b>	<b>175</b>	<b>346,593</b>

(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 1970 for all States and Territories and Australia, together with information for Australia for the four preceding years. Figures for 1968-69 and 1969-70 are subject to revision.

It should be noted that details for the years 1966, 1967 and 1968 relate to a year ended December. The change in 1969 to a June year was made to bring mineral production statistics and the annual mining census (which in previous years also related to a December year) to the same time basis as the other economic censuses conducted during that year.

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.

The statistics are derived from information supplied in returns to the various State Mines Departments and this Bureau, supplemented in some cases by information made available by the Department of National Development and by data compiled by this Bureau 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 1970, 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 1969-70 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 1969-70 and earlier years.

#### QUANTITY OF MINERALS PRODUCED: STATES AND TERRITORIES, 1969-70

Mineral		N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
<b>METALLIC MINERALS</b>										
Antimony concentrate(a)	tons	150	..	197	..	..	..	..	..	347
Bauxite	'000 tons	11	1	5,290	..	2,861	..	..	..	8,163
Beryllium ore	tons	3	..	..	..	(b)	..	..	..	..
Bismuth concentrate	"	..	..	40	..	1	..	1,699	..	1,740
Copper concentrate(c)	"	45,269	28	387,492	828	3,442	71,958	27,676	..	536,693
Copper ore(d)	"	(e)7,694	1,066	55,017	10,557	326	2,291	3,576	..	80,527
Gold—										
Bullion	oz	239	10,167	54,156	..	542,139	134	87,748	..	694,583
Ore	tons	..	..	..	900	..	..	..	..	900
Iron ore	'000 tons	..	..	..	7,308	34,130	(f)2,045	1,023	..	44,507
Iron oxide(g)	tons	26,866	395	20,258	..	..	10,179	..	..	57,698
Lead concentrate	"	359,759	..	307,390	..	271	12,879	1,595	..	681,894
Lead-copper concentrate	"	..	..	..	..	..	13,304	..	..	13,304
Lead ore(h)	"	3,623	..	36,993	83	..	..	..	..	40,699
Lead-zinc middlings	"	37,350	..	..	..	..	..	..	..	37,350
Manganese ore	"	..	..	..	369	152,209	..	627,684	..	780,262
Mineral sands—										
Ilmenite concentrate	"	11,086	..	88,054	..	677,743	..	..	..	776,883
Leucoxene concentrate	"	..	..	..	..	9,402	..	..	..	9,402
Monazite concentrate	"	402	..	107	..	3,550	..	..	..	4,059
Rutile concentrate	"	226,420	..	130,160	..	2,441	7,136	..	..	366,157
Xenotime concentrate	"	..	..	..	..	101	..	..	..	101
Zircon concentrate	"	217,966	..	90,748	..	54,537	7,507	..	..	370,758
Molybdenite concentrate	"	..	..	115	..	..	..	..	..	115
Nickel concentrate	"	..	..	..	..	157,555	..	..	..	157,555
Pyrite concentrate	"	..	..	21,585	53,928	10,863	65,938	..	..	152,314
Tantalite-columbite concentrate	lb	..	..	..	..	101,267	..	..	..	101,267
Tin concentrate(f)	tons	2,936	12	2,049	..	895	12,703	93	..	18,688
Tungsten concentrates—										
Scheelite concentrate	"	..	..	9	..	..	1,375	..	..	1,384
Wolfram concentrate	"	2	..	242	..	..	776	22	..	1,042
Zinc concentrate	"	612,537	..	176,594	..	..	84,615	2,007	..	875,753

For footnotes see next page.

## QUANTITY OF MINERALS PRODUCED: STATES AND TERRITORIES, 1969-70—continued

Mineral		N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
COAL										
Black coal—	'000 tons	34,952	..	9,417	2,121	1,159	110	..	..	47,759
Semi-anthracite	"	..	..	..	..	..	2	..	..	2
Bituminous	"	34,952	..	9,027	..	..	108	..	..	44,087
Sub-bituminous	"	..	..	390	2,121	1,159	..	..	..	3,670
Brown coal (lignite)(j)	"	..	23,927	..	..	..	..	..	..	23,927
Brown coal briquettes	"	..	1,541	..	..	..	..	..	..	1,541

## CRUDE PETROLEUM (INCLUDING NATURAL GAS)(k)

Crude oil	'000 bls	..	13,474	1,586	..	15,583	..	..	..	30,643
Natural gas (includes commercial gas and gas for field usage)	mil. cu ft	..	9,668	6,326	8,958	302	..	..	..	25,254
Natural gas condensate	bbls	..	..	839	..	..	..	..	..	839
Other derivatives—										
Commercial ethane	mil. cu ft	..	17	..	..	..	..	..	..	17
Liquified petroleum gases (LPG)—										
Commercial propane	'000 bls	..	98	..	..	..	..	..	..	98
Commercial butane	"	..	137	..	..	..	..	..	..	137

## CONSTRUCTION MATERIALS(l)

Sand	'000 tons	6,070	5,169	1,981	2,825	n.a.	198	} 954	281	{ 16,584
Gravel	"	3,531	2,753	2,121	997	n.a.	1,315			
Dimension stone	"	24	8	(b)	51	174	2	} 338	637	{ 269
Crushed and broken stone	"	10,128	15,207	3,129	10,727	4,280	1,306			
Other (decomposed rock, etc.)	"	22,638	1,664	(b)	1,489	..	120	} 338	637	{ 26,793

## OTHER NON-METALLIC MINERALS

Asbestos	short tons	794	..	..	..	30	..	..	..	824
Barite	"	315	..	..	38,611	419	..	..	..	39,345
Clays—										
Brick and shale	'000 tons	3,272	1,481	470	579	1,105	136	..	..	7,041
Other(m)	"	557	280	208	114	226	63	..	..	1,447
Diatomite	tons	2,226	..	462	..	..	..	..	..	2,688
Dolomite	"	7,519	..	13,955	305,191	..	3,424	..	..	330,089
Felspar (including cornish stone)	"	1,597	..	..	1,389	604	..	..	..	3,590
Fluorspar	"	..	609	..	..	..	..	..	..	609
Garnet concentrate	"	21	..	310	..	..	..	..	..	331
Gypsum	"	33,329	50,058	..	675,423	69,638	..	..	..	828,448
Limestone (including shell and coral)	'000 tons	2,983	2,283	1,261	1,768	1,511	537	..	..	10,344
Lithium ores	tons	..	..	..	..	765	..	..	..	765
Lithia (Li <sub>2</sub> O) content	units(n)	..	..	..	..	3,213	..	..	..	3,213
Magnesite, crude	tons	23,042	..	..	125	..	..	..	..	23,167
Mineral pigments—red ochre	"	..	..	..	..	..	41	..	..	41
Peat(o)	"	2,268	..	..	..	803	155	..	..	3,226
Pebbles—for grinding	"	..	..	..	22	..	1,307	..	..	1,329
Perlite	"	..	..	1,377	..	..	..	..	..	1,377
Phosphate rock	"	..	..	..	18,171	..	..	..	..	18,171
Pyrophyllite	"	5,000	..	..	..	..	..	..	..	5,000
Salt	'000 tons	..	(b)	(b)	556	1,015	..	..	..	2,021
Silica	tons	321,907	112,740	211,133	49,195	34,724	44,407	..	..	774,106
Sillimanite	"	894	..	..	262	..	..	..	..	1,156
Talc (including steatite and chlorite)	"	2,058	..	..	15,665	41,388	..	..	..	59,111

(a) Includes antimony ore. (b) Not available for publication. (c) Includes copper precipitate. (d) Includes cupreous ore for fertiliser. (e) Includes copper slag. (f) Iron concentrate. (g) For cement manufacture, coal washing, flux and gas purification. (h) Includes silver-lead ore, silver-lead slimes and lead slag. (i) Includes tin-copper concentrate. (j) Includes brown coal used for briquette production. (k) Source: Department of National Development and State Mines Departments. (l) Incomplete, see individual States. (m) Incomplete, owing to difficulties of coverage. (n) 1 unit = 22.4 lb. (o) Comprises peat for fertiliser and peat moss.

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

## QUANTITY OF MINERALS PRODUCED: AUSTRALIA, 1966 TO 1969-70

Mineral	1966	1967	1968	1968-69(a)	1969-70(a)
<b>METALLIC MINERALS</b>					
Antimony concentrate(b)	tons	150	154	244	261 347
Bauxite	'000 tons	1,798	4,176	4,877	6,217 8,163
Beryllium ore	tons	52	55	15	14 (c)
Bismuth concentrate	"	1	106	1,553	1,528 1,740
Chromite	"	..	138	86	.. ..
Copper concentrate(d)	"	478,710	392,679	452,100	493,037 536,693
Copper ore(e)	"	53,463	31,453	(f)39,202	(f)46,095 (f)80,527
Gold—					
Bullion	oz	1,078,587	997,793	908,286	809,100 694,583
Ore	tons	..	6	6	6 900
Iron ore	'000 tons	10,893	17,036	(g)26,204	(g)32,027 (g)44,507
Iron oxide(h)	tons	48,374	53,000	63,093	46,146 57,698
Lead concentrate	"	515,573	537,193	601,709	638,717 681,894
Lead-copper concentrate	"	12,083	12,227	12,558	12,827 13,304
Lead ore(i)	"	22,605	18,224	51,461	52,410 40,699
Lead-zinc middlings	"	10,870	14,685	5,373	3,246 37,350
Manganese ore	"	312,540	559,967	732,077	833,818 780,262
Mineral sands—					
Ilmenite concentrate	"	513,011	544,216	551,501	656,693 776,883
Leucoxene concentrate	"	756	696	1,607	8,730 9,402
Monazite concentrate	"	1,984	2,313	2,055	4,228 4,059
Rutile concentrate	"	243,858	265,514	287,617	311,662 366,157
Xenotime concentrate	"	..	18	18	38 101
Zircon concentrate	"	235,649	283,682	294,195	341,720 370,758
Molybdenite concentrate	"	4	..	10	47 115
Nickel concentrate	"	..	15,753	36,880	51,140 157,555
Osmiridium—native	oz	..	..	12	.. ..
Pyrite concentrate	tons	245,998	252,748	165,265	132,804 152,314
Tantalite-columbite concentrate	lb	10,550	79,587	238,134	202,868 101,267
Tin concentrate(j)	tons	7,604	8,557	11,297	13,889 18,688
Tungsten concentrates—					
Scheelite concentrate	"	1,308	1,202	1,465	1,563 1,384
Wolfram concentrate	"	498	448	559	734 1,042
Zinc concentrate	"	638,788	702,792	718,311	785,942 875,753
Zinc ore	"	(k)325	(k)198	2,700	11,200 ..
<b>COAL</b>					
Black coal	'000 tons	33,334	34,707	40,183	42,650 47,759
Semi-anthracite	"	45	38	31	22 2
Bituminous	"	30,045	31,299	36,665	39,008 44,087
Sub-bituminous	"	3,243	3,370	3,488	3,621 3,670
Brown coal (lignite)(l)	"	21,783	23,384	22,971	23,128 23,927
Brown coal briquettes	"	1,857	1,849	1,553	1,471 1,541
<b>CRUDE PETROLEUM (INCLUDING NATURAL GAS)</b>					
Crude oil	'000 bls	3,390	7,600	13,877	14,066 30,643
Natural gas (includes commercial gas and gas for field usage)	mil. cu ft	143	152	216	2,874 25,254
Natural gas condensate	bls	121	..	..	5 839
Other derivatives—					
Commercial ethane	mil. cu ft	..	..	..	.. 17
Liquefied petroleum gases (LPG)—					
Commercial propane	'000 bls	..	..	..	.. 98
Commercial butane	'000 bls	..	..	..	.. 137

For footnotes see next page.

## QUANTITY OF MINERALS PRODUCED: AUSTRALIA, 1966 TO 1969-70—continued

Mineral	1966	1967	1968	1968-69(a)	1969-70(a)	
<b>CONSTRUCTION MATERIALS(m)</b>						
Sand . . . . .	'000 tons	10,666	11,149	14,406	16,711	16,584
Gravel . . . . .	" "	8,549	9,048	8,340	10,343	11,609
Dimension stone . . . . .	" "	241	286	275	286	269
Crushed and broken stone . . . . .	" "	46,796	46,268	44,375	42,925	45,739
Other . . . . .	" "	22,216	25,202	26,581	23,376	26,793

## OTHER NON-METALLIC MINERALS

Asbestos . . . . .	short tons	13,468	600	897	821	824
Barite . . . . .	tons	13,724	15,666	39,155	45,579	39,345
Clays—						
Brick and shale . . . . .	'000 tons	5,187	5,697	6,422	7,154	7,041
Other(m) . . . . .	" "	952	961	1,396	1,275	1,447
Diatomite . . . . .	tons	7,592	11,103	6,725	2,643	2,688
Dolomite . . . . .	" "	256,008	290,659	316,731	305,644	330,089
Felspar (including cornish stone) . . . . .	" "	7,259	4,450	4,838	5,742	3,590
Garnet concentrate . . . . .	" "	239	591	167	322	331
Gypsum . . . . .	" "	801,552	914,084	843,744	894,560	828,448
Limestone (including shell and coral) . . . . .	'000 tons	7,730	8,355	8,470	9,078	10,344
Lithium ores . . . . .	tons	933	667	738	817	765
Lithia (Li <sub>2</sub> O) content . . . . .	units(n)	3,919	2,906	3,112	3,443	3,213
Loam—for foundry moulding . . . . .	tons	9,506	(o)	(o)	(o)	(o)
Magnesite, crude . . . . .	" "	19,556	23,653	23,146	23,343	23,167
Mineral pigments—red ochre . . . . .	" "	272	358	526	654	41
Peat(p) . . . . .	" "	..	..	..	2,134	3,226
Pebbles—for grinding . . . . .	" "	1,043	1,305	1,321	1,100	1,329
Perlite . . . . .	" "	1,544	1,389	1,049	795	1,377
Phosphate rock . . . . .	" "	5,715	11,770	5,744	10,557	18,171
Pyrophyllite . . . . .	" "	..	..	501	1,933	5,000
Salt . . . . .	'000 tons	645	703	900	1,001	2,021
Silica . . . . .	" "	347,123	443,555	542,680	618,427	774,106
Sillimanite . . . . .	" "	2,664	1,183	2,115	1,908	1,156
Talc (including steatite and chlorite) . . . . .	" "	17,327	17,779	38,280	41,506	59,111

(a) Year ended 30 June. (b) Includes antimony ore. (c) Not available for publication. (d) Includes copper precipitate. (e) Includes cupreous ore for fertiliser. (f) Includes copper slag. (g) Includes iron concentrate. (h) For cement manufacture, coal washing, flux and gas purification. (i) Includes silver-lead ore, silver-lead slimes and lead slag. (j) Includes tin-copper concentrate. (k) Zinc ore for fertiliser. (l) Includes brown coal used for briquette production. (m) Incomplete, owing to difficulties of coverage. (n) 1 unit = 22.4 lb. (o) Included in silica. (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

In the foregoing tables the section headed "Metallic Minerals" contains statistics of ores and concentrates produced. The following tables contain statistics of the metallic content of these ores and concentrates. The figures are the result of assays carried out on the ores and concentrates and may not represent the ultimate yield of metals produced after smelting and refining.

CONTENTS OF METALLIC MINERALS PRODUCED  
STATES AND NORTHERN TERRITORY, 1969-70

Content of metallic minerals produced	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	Aust.
Alumina (Al <sub>2</sub> O <sub>3</sub> )	'000 tons	4	3,095	..	1,058	..	..	4,158
Antimony	tons	920	34	..	..	..	..	954
Beryllium oxide (BeO)	units(a)	30	..	..	(b)	..	..	(b)
Bismuth	lb	..	21,101	..	1,196	..	421,420	443,717
Cadmium	tons	1,233	..	..	..	76	9	1,318
Cobalt	..	136	..	..	170	..	..	306
Copper	..	15,550	41	93,363	245	2,565	21,333	6,858
Gold	fine oz	10,570	8,671	77,942	933	397,135	43,558	123,840
Iron(c)	'000 tons	..	..	4,649	21,514	(d)1,419	640	28,223
Lead	tons	285,877	..	150,339	9	179	932	452,102
Manganese(e)	..	6,080	..	..	76,612	259	307,331	390,282
Manganese dioxide (MnO <sub>2</sub> )(f)	..	..	..	109	..	..	..	109
Mercury	lb	..	..	..	..	3,231	..	3,231
Molybdenum disulphide (MoS <sub>2</sub> )	..	..	218,960	..	..	..	..	218,960
Monazite	tons	361	100	..	3,195	..	..	3,656
Nickel	..	..	..	..	17,762	..	..	17,762
Platinum	oz	..	..	..	592	..	..	592
Silver	'000 fine oz	10,996	..	14,393	1	118	1,774	216
Sulphur(g)	tons	248,838	..	10,801	23,189	4,982	66,272	1,588
Tantalite-columbite (Ta <sub>2</sub> O <sub>5</sub> + Nb <sub>2</sub> O <sub>5</sub> )	lb	..	..	..	63,917	..	..	63,917
Tin	tons	1,715	9	1,265	..	609	5,040	8,695
Titanium dioxide (TiO <sub>2</sub> )	..	222,350	..	169,709	..	391,643	6,741	790,443
Tungstic oxide (WO <sub>3</sub> )	units(a)	156	..	17,593	..	..	154,550	930
Yttrium oxide (Y <sub>2</sub> O <sub>3</sub> )	lb	..	..	..	..	47,187	..	47,187
Zinc	tons	345,296	..	91,324	..	..	50,449	1,107
Zirconium dioxide (ZrO <sub>2</sub> )	..	145,072	..	60,378	..	35,696	4,949	..

(a) 1 unit = 22.4 lb. (b) Not available for publication. (c) Excludes iron content of iron oxide not intended for metal extraction. (d) 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 (U<sub>3</sub>O<sub>8</sub>) are not available for publication.

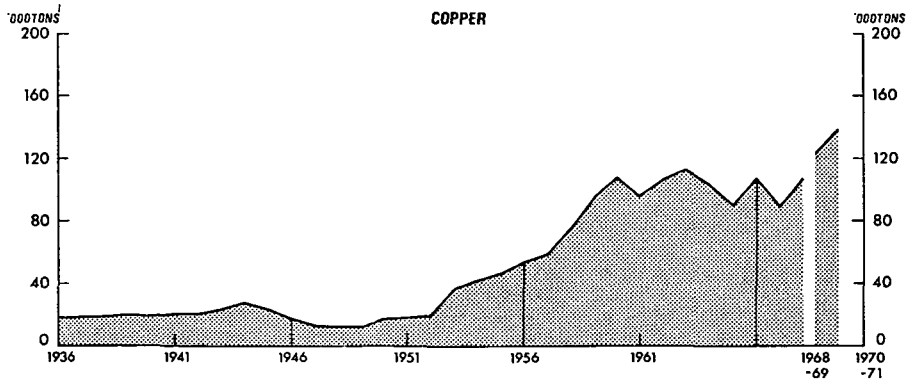
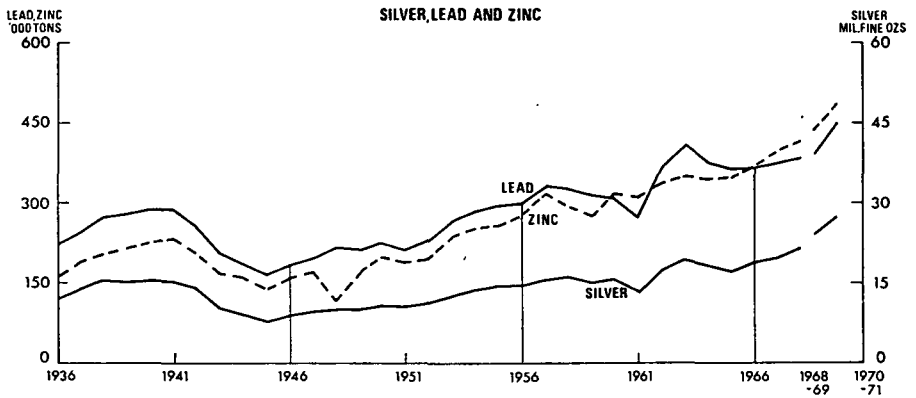
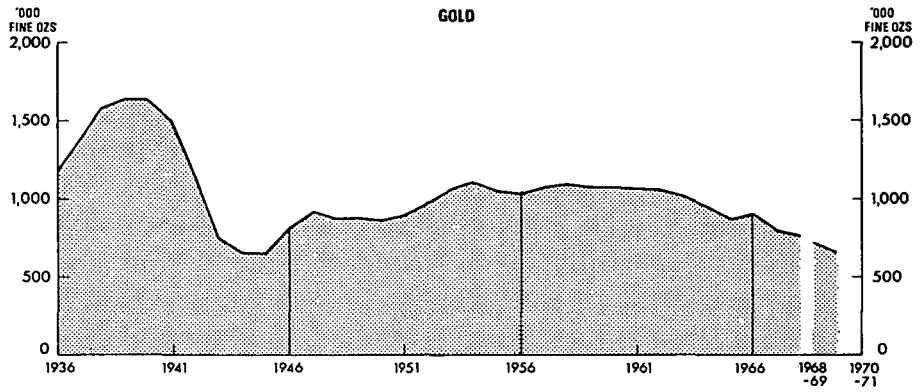
## CONTENTS OF METALLIC MINERALS PRODUCED: AUSTRALIA, 1966 TO 1969-70

Content of metallic minerals produced	1966	1967	1968	1968-69 (a)	1969-70 (a)
Alumina (Al <sub>2</sub> O <sub>3</sub> )	'000 tons	939	2,258	2,633	3,207
Antimony	tons	971	930	842	854
Beryllium oxide (BeO)	units(b)	637	675	178	123
Bismuth	lb	717	25,536	403,200	421,680
Cadmium	tons	1,212	1,324	1,359	1,210
Chromic oxide (Cr <sub>2</sub> O <sub>3</sub> )	..	..	44	27	..
Cobalt	..	84	146	235	212
Copper	..	109,537	90,361	107,906	122,789
Gold	fine oz	916,985	805,336	781,782	729,565
Iron(d)	'000 tons	6,956	10,928	(e)16,920	(e)20,502
Lead	tons	364,898	375,779	382,671	391,534
Manganese(f)	..	151,401	264,660	345,099	372,525
Manganese dioxide (MnO <sub>2</sub> )(g)	..	4,091	228	134	148
Mercury	lb	..	4,204	2,147	3,452
Molybdenum disulphide (MoS <sub>2</sub> )	..	5,549	..	19,164	89,624
Monazite	tons	1,836	2,163	1,849	3,784
Nickel	..	..	2,061	4,603	6,086
Osmiridium	oz	..	..	12	..
Palladium	..	..	..	..	352
Platinum	..	13	..	..	519
Silver	'000 fine oz	18,888	19,842	21,394	22,410
Sulphur(h)	tons	371,567	392,371	349,990	313,836
Tantalite-columbite (Ta <sub>2</sub> O <sub>5</sub> + Nb <sub>2</sub> O <sub>5</sub> )	lb	5,698	32,906	56,179	17,645
Tin	tons	4,807	5,586	6,537	7,411
Titanium dioxide (TiO <sub>2</sub> )	..	516,745	552,894	578,720	666,050
Tungstic oxide (WO <sub>3</sub> )	units(a)	130,776	119,210	144,552	163,111
Yttrium oxide (Y <sub>2</sub> O <sub>3</sub> )	lb	..	9,475	9,500	16,312
Zinc	tons	369,341	400,527	415,722	437,385
Zirconium dioxide (ZrO <sub>2</sub> )	..	156,581	188,462	195,585	231,234

(a) Year ended 30 June. (b) 1 unit = 22.4 lb. (c) Not available for publication. (d) Excludes iron content of iron oxide not intended for metal extraction. (e) Includes iron contained in iron concentrate. (f) Content of metallurgical grade manganese ore and zinc concentrate. (g) Content of manganese ore of other than metallurgical grade. (h) Sulphur content of pyrite and other minerals from which sulphur is recovered.

NOTE. Particulars of production of uranium oxide (U<sub>3</sub>O<sub>8</sub>) are not available for publication.

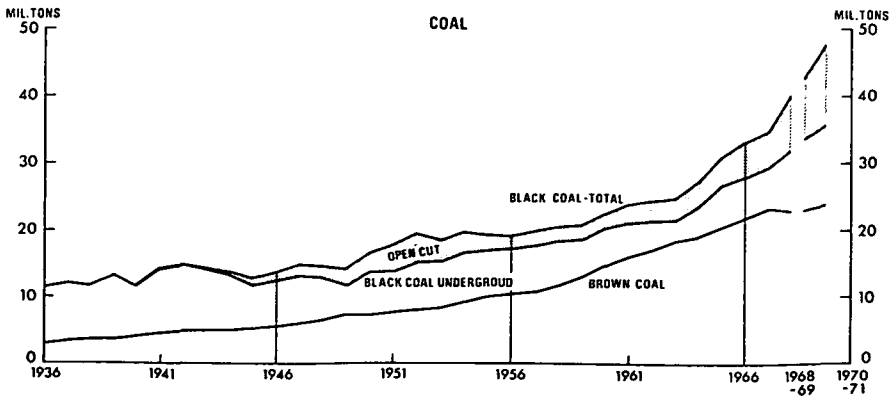
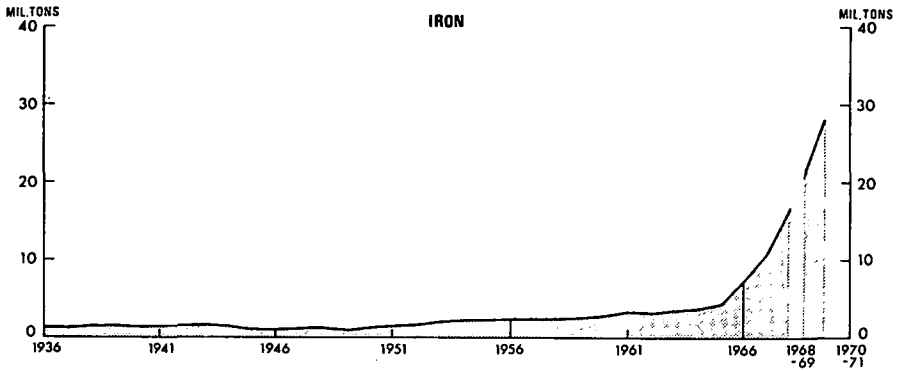
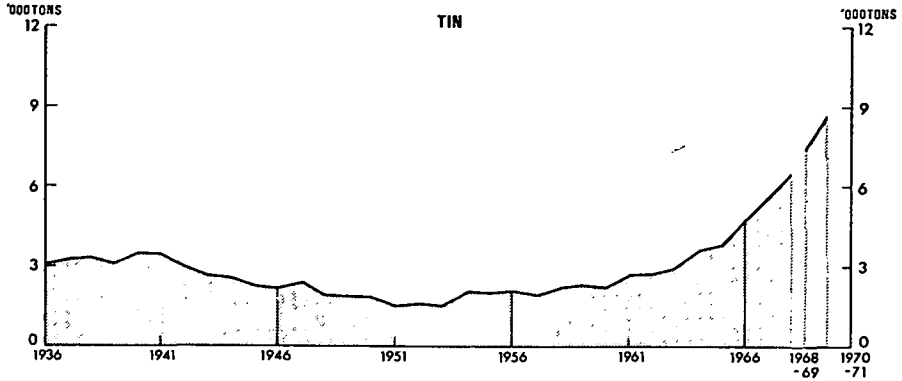
### MINE PRODUCTION OF PRINCIPAL METALS: AUSTRALIA (METALLIC CONTENT OF MINERALS) 1936 TO 1969-70



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

MINE PRODUCTION OF PRINCIPAL METALS  
AND PRODUCTION OF COAL  
(METALLIC CONTENT OF MINERALS)

AUSTRALIA, 1936 TO 1969-70



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 1969-70 and earlier years.

VALUE OF MINERALS PRODUCED: AUSTRALIA, 1966 TO 1969-70  
(\$'000)

Mineral	1966	1967	1968	1968-69(a)	1969-70(a)
<b>METALLIC MINERALS</b>					
Antimony—					
Concentrate . . . . .				83	84
Ore . . . . .	43	54	83	..	1
Bauxite . . . . .	(b)	(b)	(b)	(b)	(b)
Beryllium ore . . . . .	14	21	7	7	(b)
Bismuth concentrate . . . . .	2	139	1,979	2,087	2,441
Chromite . . . . .	..	7	4	..	..
Copper—					
Concentrate . . . . .				103,651	145,268
Ore . . . . .	87,523	72,515	(c)92,396	(c)2,334	(c)2,816
Ore for fertiliser . . . . .				80	56
Precipitate . . . . .				352	230
Gold—					
Bullion(d) . . . . .	26,371	24,456	23,525	22,953	19,945
Ore . . . . .	..	..	..	..	26
Iron ore . . . . .	41,728	82,994	131,482	193,435	259,608
Iron oxide . . . . .	289	501	578	542	645
Lead concentrate . . . . .				80,556	99,507
Lead-copper concentrate . . . . .	76,831	73,654	89,705	4,043	4,760
Lead ore(e) . . . . .				797	464
Lead-zinc middlings . . . . .				303	3,032
Manganese ore . . . . .	3,462	8,007	8,358	10,734	9,680
Mineral sands(f)—					
Ilmenite concentrate . . . . .	4,242	4,390	4,572	5,380	6,638
Leucoxene concentrate . . . . .	29	33	70	358	420
Monazite concentrate . . . . .	203	289	237	501	493
Rutile concentrate . . . . .	17,088	19,615	21,528	23,388	31,246
Xenotime concentrate . . . . .	..	45	45	76	119
Zircon concentrate . . . . .	8,255	10,937	10,967	11,481	11,827
Molybdenite concentrate . . . . .	6	..	(b)	76	175
Nickel concentrate . . . . .	..	(b)	(b)	(b)	(b)
Osmiridium-native . . . . .	..	..	2	..	..
Pyrite concentrate . . . . .	(b)	(b)	1,842	1,713	1,473
Tantalite-columbite					
Concentrate . . . . .	19	(b)	(b)	261	276
Tin concentrate . . . . .	14,332	15,011	16,691	19,215	26,773
Tin-copper concentrate . . . . .	..	..	(b)	469	915
Tungsten concentrates . . . . .	4,469	4,509	5,514	6,723	8,753
Zinc concentrate . . . . .				35,285	45,896
Zinc ore . . . . .	32,890	29,354	30,398	112	..
Zinc ore for fertiliser . . . . .				..	..
<b>Total metallic minerals</b> . . . . .	<b>327,633</b>	<b>370,892</b>	<b>468,172</b>	<b>562,981</b>	<b>762,134</b>
<b>COAL</b>					
Black coal . . . . .	151,380	160,099	188,785	198,713	242,014
Brown coal (lignite) . . . . .	20,064	20,686	21,555	20,880	21,165
<b>Total coal</b> . . . . .	<b>171,444</b>	<b>180,785</b>	<b>210,340</b>	<b>219,593</b>	<b>263,179</b>
<b>CRUDE PETROLEUM (INCLUDING NATURAL GAS)</b>					
Crude petroleum (including natural gas) . . . . .	9,229	21,286	39,307	40,513	87,020



VALUE OF MINERALS PRODUCED: AUSTRALIA, 1966 TO 1969-70—*continued*  
(\$'000')

<i>Mineral</i>	1966	1967	1968	1968-69(a)	1969-70(a)
<b>CONSTRUCTION MATERIALS</b>					
<i>Construction materials(g)</i> . . . . .	83,449	91,789	96,812	115,062	130,437
<b>OTHER NON-METALLIC MINERALS</b>					
Asbestos . . . . .	2,224	108	181	180	174
Barite . . . . .	199	214	410	409	437
Clay—					
Brick clay and shale . . . . .	6,004	6,472	7,042	6,905	7,073
Other clays . . . . .	1,650	1,729	2,122	1,808	2,334
Diatomite . . . . .	62	71	52	21	21
Dolomite . . . . .	579	674	720	699	825
Felspar (including cornish stone) . . . . .	81	43	42	57	49
Fluorspar . . . . .	..	..	..	..	14
Garnet concentrate . . . . .	4	4	2	5	4
Gems(h) . . . . .	5,064	4,605	6,575	9,260	14,541
Gypsum . . . . .	2,006	2,119	2,171	2,284	2,198
Limestone (including shell and coral) . . . . .	10,277	11,700	11,963	13,364	14,657
Lithium ores . . . . .	14	9	9	13	12
Loam—for foundry moulding . . . . .	17	(i)	(i)	(i)	(i)
Magnesite, crude . . . . .	196	256	228	238	272
Mineral pigments—red ochre . . . . .	3	5	7	10	1
Peat(j) . . . . .	n.a.	n.a.	n.a.	26	59
Pebbles—for grinding . . . . .	19	22	23	17	24
Perlite . . . . .	3	3	7	5	14
Phosphate rock . . . . .	23	47	23	42	73
Pyrophyllite . . . . .	..	..	7	22	45
Salt . . . . .	2,626	2,769	3,600	4,474	8,497
Silica . . . . .	533	772	1,038	1,486	2,542
Sillimanite . . . . .	58	29	47	44	30
Talc (including steatite and chlorite) . . . . .	278	295	657	617	946
<i>Total other non-metallic minerals</i> . . . . .	31,921	31,946	36,928	41,987	54,841
<b>TOTAL</b>					
<b>Total, all minerals and construction materials</b> . . . . .	<b>623,678</b>	<b>696,701</b>	<b>851,562</b>	<b>980,134</b>	<b>1,297,610</b>
<i>Of which—</i>					
New South Wales . . . . .	262,358	274,123	298,392	314,802	383,743
Victoria . . . . .	53,075	57,339	59,026	58,648	99,234
Queensland . . . . .	138,483	135,379	185,753	209,432	277,675
South Australia . . . . .	41,954	40,449	42,064	72,325	85,617
Western Australia . . . . .	78,918	134,319	195,316	234,854	339,879
Tasmania . . . . .	34,561	34,688	44,968	59,191	77,554
Northern Territory . . . . .	13,283	19,316	24,846	29,332	32,373
Australian Capital Territory . . . . .	1,046	1,087	1,195	1,550	1,535

(a) Year ended 30 June. (b) Not available for publication. (c) Includes value of copper slag. (d) Includes alluvial gold. (e) Includes value of silver-lead ore, silver-lead slimes and lead slag. (f) Excludes rutile-zircon concentrates shipped interstate for final separation. (g) Incomplete owing to difficulties of coverage in some States. (h) Mainly opals and sapphires. (i) Included in silica. (j) Comprises peat for fertiliser and peat moss.

## Overseas participation in Australian mining industry

For the latest information available concerning overseas ownership and control in Australian mining industry see Year Book No. 57, pages 932-5.

### 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 (excluding petroleum exploration), which is carried out by this Bureau in association with some State Mines Departments.

#### 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. It should be noted that data for the six months ended 31 December 1968 are included in both the 1968 and 1968-69 figures in these tables.

#### Scope of mineral exploration census

The scope of the census comprises the following activities.

(a) *Private exploration on production leases*—relates to exploration carried out *on the production lease* by privately operated mines currently producing or under development for production of minerals other than petroleum. This also includes particulars of exploration within their production leases by business undertakings operated by State government authorities. Mines included in this section of the mineral exploration census are also included in the annual mining census with the exception of a limited number of itinerant prospectors and small mines for which information was not collected.

(b) *Private 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 other than petroleum.

(c) *Other private exploration*—relates to exploration for minerals other than petroleum, which is not directly connected with areas under lease, licence, etc., including general surveys, aerial surveys, report writing, map preparation and other off-site activities not directly attributable to particular leases or licence areas.

(d) *Exploration by government*—relates to exploration for minerals other than petroleum carried out by—

- (i) Commonwealth Government (Bureau of Mineral Resources, Geology and Geophysics, and Joint Coal Board), and
- (ii) State Mines Departments.

Prior to 1968 the scope of the census was limited to private exploration on lease or licence areas held for production and exploration purposes, and all Government exploration. The scope was broadened for the 1968 census to include other private exploration activity as described in (c) above.

**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 of these categories. In 1970-71 separate details of man-weeks worked by 'working proprietors and working partners' were collected and details for 1970-71 are shown separately in the table on page 930.

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

The following table shows expenditure, employment and footage drilled, etc., on mineral exploration other than for petroleum in each State and the Northern Territory during the years 1967 to 1970-71.

**MINERAL EXPLORATION (OTHER THAN FOR PETROLEUM)  
STATES AND NORTHERN TERRITORY, 1967 TO 1970-71**

	EXPENDITURE(a)				
	(\$'000)				
	1967(b)(c)	1968(c)	1968-69	1969-70	1970-71
<b>PRIVATE EXPLORATION</b>					
New South Wales . . . . .	4,594	5,620	7,272	16,562	21,238
Victoria . . . . .	1,452	1,476	1,600	2,353	1,853
Queensland . . . . .	11,657	13,343	18,018	25,078	32,662
South Australia . . . . .	1,203	2,661	2,961	5,760	6,220
Western Australia . . . . .	10,203	23,148	35,412	59,821	86,082
Tasmania . . . . .	2,180	2,059	2,408	3,299	4,397
Northern Territory . . . . .	3,532	4,156	4,891	5,241	8,610
<i>Total</i> . . . . .	<i>34,822</i>	<i>52,463</i>	<i>72,562</i>	<i>118,115</i>	<i>161,063</i>
<b>GOVERNMENT EXPLORATION</b>					
Commonwealth(d) . . . . .	2,803	3,529	3,591	3,995	3,928
State Mines Departments . . . . .	1,768	2,329	2,939	2,708	3,386
<i>Total</i> . . . . .	<i>4,571</i>	<i>5,858</i>	<i>6,530</i>	<i>6,704</i>	<i>7,314</i>
<b>TOTAL EXPENDITURE</b>					
On drilling . . . . .	15,490	20,448	26,196	33,522	45,106
Other . . . . .	23,903	37,873	52,896	91,296	123,272
<b>Australia</b> . . . . .	<b>39,393</b>	<b>58,321</b>	<b>79,092</b>	<b>124,818</b>	<b>168,377</b>
Payments to contractors(e) . . . . .	12,181	18,506	27,721	40,969	54,578

For footnotes see next page.

**MINERAL EXPLORATION (OTHER THAN FOR PETROLEUM): STATES AND  
NORTHERN TERRITORY, 1967 TO 1970-71—continued**

<b>EMPLOYMENT(<i>f</i>)</b>					
('000 man-weeks worked)					
	1967( <i>b</i> )( <i>c</i> )	1968( <i>c</i> )	1968-69	1969-70	1970-71
<b>PRIVATE EXPLORATION</b>					
New South Wales . . . . .	22.5	20.9	26.1	30.7	40.7
Victoria . . . . .	5.6	7.0	6.3	5.7	5.1
Queensland . . . . .	27.2	33.3	36.5	48.4	60.7
South Australia . . . . .	3.6	7.2	9.2	10.9	11.2
Western Australia . . . . .	37.6	52.8	67.5	103.3	135.5
Tasmania . . . . .	7.4	7.5	7.4	8.8	11.4
Northern Territory . . . . .	8.8	11.0	10.8	12.7	17.4
<i>Total</i> . . . . .	112.6	139.6	163.9	220.5	282.1
<b>GOVERNMENT EXPLORATION</b>					
Commonwealth( <i>d</i> ) . . . . .	14.2	11.9	11.7	16.5	18.1
State Mines Departments . . . . .	15.9	13.7	17.0	20.9	21.1
<i>Total</i> . . . . .	30.1	25.5	28.7	37.4	39.2
<b>TOTAL</b>					
By working proprietors and working partners . . . . .	( <i>g</i> )	( <i>g</i> )	( <i>g</i> )	( <i>g</i> )	7.2
By professional persons( <i>h</i> ) . . . . .	46.7	49.9	57.6	73.1	94.5
By non-professional persons( <i>i</i> ) . . . . .	96.0	115.2	135.0	184.8	219.5
<i>Australia</i> . . . . .	142.7	165.1	192.6	257.9	321.2
<b>FOOTAGE DRILLED, SUNK OR DRIVEN</b>					
('000 ft)					
<b>PRIVATE EXPLORATION</b>					
New South Wales . . . . .	908	1,031	1,146	1,528	1,657
Victoria . . . . .	182	128	141	137	100
Queensland . . . . .	2,029	1,669	1,873	1,959	2,797
South Australia . . . . .	161	227	250	614	654
Western Australia . . . . .	907	1,768	2,493	6,344	6,661
Tasmania . . . . .	152	149	177	192	307
Northern Territory . . . . .	259	303	352	292	451
<i>Total</i> . . . . .	4,598	5,273	6,432	11,066	12,627
<b>GOVERNMENT EXPLORATION</b>					
Commonwealth( <i>d</i> ) . . . . .	6	15	21	28	10
State Mines Departments . . . . .	290	282	314	283	274
<i>Total</i> . . . . .	296	297	335	311	284
<b>TOTAL FOOTAGE DRILLED, SUNK OR DRIVEN(<i>j</i>)</b>					
Drilled—core . . . . .	1,727	2,003	2,641	3,045	3,114
non-core . . . . .	3,138	3,445	3,916	8,101	9,224
Sunk or driven . . . . .	30	122	210	231	574
<i>Australia</i> . . . . .	4,896	5,570	6,767	11,376	12,912

(*a*) Expenditure whether charged as working expenses or capitalised. (*b*) Excludes 'Other private exploration', not collected prior to 1968; see text. (*c*) Year ended 31 December. (*d*) Bureau of Mineral Resources and Joint Coal Board. (*e*) Included in expenditure shown above. Comprises amounts paid to drilling contractors, geological consultants, technical advisers, etc., for exploration services. (*f*) Operator and staff only (includes time spent on report writing and similar off-site activities associated with exploration); excludes contractors and their employees. (*g*) Not collected separately prior to 1970-71. Included in professional and non-professional employment; see text page 929. (*h*) Geologists, geophysicists, engineers, etc., engaged on exploration work. (*i*) Drill operators, field hands, etc. (*j*) '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), *The Australian Mineral Industry—Annual Review and Expenditure on Petroleum Exploration and Development*, 1965 (B.M.R. Record No. 1966 (205)).

### 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, 1967 TO 1970 (\$'000)

	1967	1968	1969	1970
<b>PRIVATE SOURCES(a)</b>				
Utilised in—				
New South Wales . . . . .	1,284	1,126	2,473	2,597
Victoria . . . . .	15,892	19,538	18,415	11,538
Queensland . . . . .	5,875	5,178	7,058	5,474
South Australia . . . . .	6,257	2,979	3,669	6,431
Western Australia . . . . .	11,788	21,532	26,194	29,557
Tasmania . . . . .	2,424	999	1,837	4,708
Northern Territory . . . . .	6,978	6,222	7,064	13,753
<i>Australia</i> . . . . .	<i>50,497</i>	<i>57,573</i>	<i>66,711</i>	<i>74,059</i>
<b>GOVERNMENT SOURCES</b>				
Payments under <i>Petroleum Search Subsidy Act</i> 1959–1969—				
Utilised in—				
New South Wales . . . . .	516	474	548	406
Victoria . . . . .	727	1,940	441	732
Queensland . . . . .	1,767	1,419	1,524	1,623
South Australia . . . . .	1,058	1,407	609	923
Western Australia . . . . .	3,441	4,027	6,286	4,604
Tasmania . . . . .	469	497	903	395
Northern Territory . . . . .	1,657	1,448	2,561	1,061
<i>Total subsidy payments, Australia</i> . . . . .	<i>9,635</i>	<i>11,213</i>	<i>12,871</i>	<i>9,744</i>
Utilised for—				
Geophysical . . . . .	4,512	3,590	3,557	2,924
Drilling . . . . .	5,123	7,622	9,315	6,820
Other Government sources—				
Commonwealth(a) . . . . .	4,508	4,756	4,238	3,841
State Mines Departments . . . . .	466	783	832	456
<i>Total other sources, Australia</i> . . . . .	<i>4,974</i>	<i>5,540</i>	<i>5,070</i>	<i>4,296</i>
<i>Total Government sources, Australia</i> . . . . .	<i>14,609</i>	<i>16,752</i>	<i>17,941</i>	<i>14,040</i>
<b>TOTAL FUNDS, PRIVATE AND GOVERNMENT</b>				
<i>Australia</i> . . . . .	<i>65,106</i>	<i>74,325</i>	<i>84,652</i>	<i>88,099</i>

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

**SUMMARY OF EXPLORATION WELLS AND FOOTAGE DRILLED IN PETROLEUM  
EXPLORATION: STATES AND TERRITORIES, 1970**

		<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>
<b>Wells—</b>									
Drilled (i.e. those which reached final depth)—									
As oil producers . . . . .	No.	..	..	7	1	1	..	..	2
As gas producers . . . . .	No.	1	..	..	6	..	..	1	15
Plugged and abandoned . . . . .	No.	11	17	43	16	14	4	3	108
<b>Total . . . . .</b>	<b>No.</b>	<b>12</b>	<b>17</b>	<b>50</b>	<b>23</b>	<b>15</b>	<b>4</b>	<b>4</b>	<b>125</b>
Average final depth of wells drilled . . . . .	ft	2,588	5,086	4,807	6,300	6,654	8,787	5,352	5,361
Drilling still in progress at 31 December (uncompleted holes) . . . . .	No.	..	..	1	1	4	..	2	8
Wells drilled or drilling over 10,000 feet . . . . .	No.	..	2	4	5	5	2	1	19
<b>Footage drilled—</b>									
Completed wells . . . . .	ft	31,061	86,462	230,515	134,538	91,037	35,149	22,980	631,732
Uncompleted holes . . . . .	ft	..	..	9,841	10,352	28,737	..	3,780	52,710
<b>Total . . . . .</b>	<b>ft</b>	<b>31,061</b>	<b>86,462</b>	<b>240,346</b>	<b>144,890</b>	<b>119,774</b>	<b>35,149</b>	<b>26,760</b>	<b>684,442</b>

**SUMMARY OF EXPLORATION WELLS AND FOOTAGE DRILLED IN PETROLEUM  
EXPLORATION: AUSTRALIA, 1967 TO 1970**

		<i>1967</i>	<i>1968</i>	<i>1969</i>	<i>1970</i>
<b>Wells—</b>					
Drilled (i.e. those which reached final depth)—					
As oil producers . . . . .	No.	4	1	..	2
As gas producers . . . . .	No.	7	4	6	15
Plugged and abandoned . . . . .	No.	72	78	101	108
<b>Total . . . . .</b>	<b>No.</b>	<b>83</b>	<b>83</b>	<b>107</b>	<b>125</b>
Average final depth of wells drilled . . . . .	ft	5,575	6,135	6,170	5,361
Drilling still in progress at 31 December (uncompleted holes) . . . . .	No.	8	8	11	8
Wells drilled or drilling over 10,000 ft . . . . .	No.	11	13	24	19
<b>Footage drilled—</b>					
Completed wells . . . . .	ft	373,336	453,318	604,683	631,732
Uncompleted holes . . . . .	ft	48,332	57,729	70,922	52,710
<b>Total . . . . .</b>	<b>ft</b>	<b>421,668</b>	<b>513,047</b>	<b>675,605</b>	<b>684,442</b>

### 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 the years 1965-66 to 1969-70.

**PRODUCTION OF PRINCIPAL MANUFACTURED PRODUCTS  
OF MINERAL ORIGIN: AUSTRALIA, 1965-66 TO 1969-70**

Commodity	1965-66	1966-67	1967-68	1968-69p	1969-70p
<b>METALS(a)</b>					
<b>Non-ferrous—</b>					
Alumina . . . . . tons	227,077	474,716	1,136,208	1,591,802	1,995,474
Refined aluminium . . . . . "	87,222	92,826	87,733	109,998	165,709
Blister copper(b) . . . . . "	98,529	77,788	75,344	109,582	108,852
Refined copper . . . . . "	91,588	74,313	72,166	94,731	103,680
Lead bullion (for export)(b) . . . . . "	81,709	84,690	101,477	132,218	169,007
Refined lead . . . . . "	188,197	192,384	186,908	175,664	185,366
Refined zinc . . . . . "	196,534	197,030	187,325	228,198	257,674
Refined tin . . . . . "	3,524	3,224	3,955	3,960	4,637
<b>Ferrous—</b>					
Pig iron . . . . . '000 tons	4,380	4,893	5,209	5,722	5,888
Steel ingots . . . . . "	5,561	6,114	6,287	6,599	6,766
<b>Precious—</b>					
Refined gold(c) . . . . . '000 f oz	774	726	655	622	527
Refined silver . . . . . "	8,766	9,825	9,693	9,428	10,581
<b>FUELS</b>					
<b>Coal products—</b>					
Metallurgical coke . . . . . '000 tons	3,179	3,365	3,678	3,647	3,994
Brown coal briquettes . . . . . "	1,883	1,820	1,745	1,471	1,539
<b>Petroleum products—</b>					
Motor spirit . . . . . mil. gal	1,524	1,763	1,897	2,032	2,110
Furnace fuel . . . . . '000 tons	5,340	5,759	6,206	6,113	5,987
Automotive distillate . . . . . "	1,829	2,167	2,344	2,579	2,852
Industrial diesel fuel . . . . . "	859	901	984	1,038	1,080
<b>BUILDING MATERIALS</b>					
Clay bricks . . . . . millions	1,360	1,361	1,440	1,612	1,697
Portland cement . . . . . '000 tons	3,688	3,661	3,805	4,075	4,439
Plaster of paris . . . . . "	266	261	278	282	303
Plaster sheets . . . . . '000 sq yd	29,917	30,601	32,809	35,310	39,594
<b>CHEMICALS</b>					
Sulphuric acid . . . . . '000 tons	1,781	1,991	1,892	1,853	1,748
Caustic soda . . . . . tons	75,229	91,009	98,190	105,478	111,107
Superphosphate . . . . . '000 tons	4,265	4,430	3,935	3,879	3,598

(a) Excludes secondary metal with the exception of pig iron and steel ingots. (b) metallic content. (c) Newly-won gold of Australian origin.

## 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 Commonwealth Bureau of Census and 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 the years 1968-69 to 1970-71 are shown in the following table.

**EXPORTS AND IMPORTS OF PRINCIPAL MINERALS AND MINERAL PRODUCTS  
AUSTRALIA, 1968-69 TO 1970-71**

Commodity(a)	Quantity			Value (\$'000 f.o.b.)			
	1968-69	1969-70	1970-71	1968-69	1969-70	1970-71	
<b>EXPORTS(b)</b>							
Alumina . . . . .	'000 tons	n.a.	n.a.	1,778	75,806	80,987	95,125
Aluminium and aluminium base alloys—							
Unworked shapes . . . . .	tons	8,226	49,724	78,403	4,304	22,972	35,962
Rolled, drawn and extruded shapes . . . . .	..	2,683	2,005	3,576	1,812	1,295	3,079
Coal . . . . .	'000 tons	13,815	17,345	18,697	117,103	164,498	193,725
Copper—							
Ore and concentrate . . . . .	tons	41,073	64,082	138,003	9,769	14,620	32,031
Blister . . . . .	..	7,551	7,903	6,862	9,938	13,256	8,992
Ingots, pigs (refined) . . . . .	..	26,649	38,014	35,446	27,337	54,733	35,521
Rolled, drawn and extruded shapes . . . . .	..	10,101	10,350	12,682	11,645	16,103	16,722
Gold, refined . . . . .	fine oz	447,929	473,411	76,646	15,894	16,377	2,451
Ilmenite concentrate . . . . .	tons	495,231	586,798	630,935	5,229	5,888	6,471
Iron and steel—							
Iron ore . . . . .	'000 tons	20,072	33,244	47,558	179,515	277,810	375,388
Pig iron . . . . .	tons	346,183	306,156	383,567	13,105	14,742	21,587
Ingots, blooms and slabs . . . . .	..	424,838	444,077	115,359	23,858	30,945	9,596
Tinplate . . . . .	..	44,029	56,487	45,981	5,410	8,086	8,037
Scrap . . . . .	..	481,982	520,967	460,926	11,751	17,039	17,412
Lead—							
Ore and concentrate . . . . .	..	113,343	119,468	81,784	22,020	23,320	16,290
Lead-silver bullion . . . . .	..	126,348	167,074	176,971	39,262	60,461	56,455
Pig . . . . .	..	115,415	152,273	121,210	24,994	43,285	29,023
Manganese ore . . . . .	..	629,531	630,470	692,541	11,837	11,440	12,961
Opals . . . . .	..	..	..	..	11,883	12,272	11,365
Petroleum oils—							
Gasolines and solvents . . . . .	'000 gal	63,539	56,389	57,262	6,890	5,979	7,664
Kerosenes . . . . .	..	23,717	40,372	64,522	2,889	4,327	7,191
Automotive distillate, industrial and marine diesel fuels and heavy distillate, n.e.i. . . . .	..	48,291	67,066	103,576	4,225	5,408	8,550
Residual oils . . . . .	..	70,289	103,721	68,641	3,984	3,797	3,100
Lubricating oil . . . . .	..	24,804	23,112	35,063	7,497	7,136	10,715
Rutile concentrate . . . . .	tons	286,080	340,964	374,906	22,844	30,209	36,399
Silver—refined ingot bar . . . . .	'000 fine oz	11,667	7,942	7,959	21,695	13,350	12,237
Tin ores and concentrates . . . . .	tons	6,387	7,031	6,243	8,959	10,453	7,636
Tungsten concentrates—							
Scheelite concentrate . . . . .	..	1,771	1,409	1,205	4,407	4,225	3,607
Wolfram concentrate . . . . .	..	679	949	986	1,929	3,494	4,100
Zinc—							
Ore and concentrate . . . . .	..	332,619	430,216	381,217	21,820	30,503	25,739
Refinery type shapes . . . . .	..	115,562	152,273	134,506	27,291	38,736	35,671
Zircon concentrate . . . . .	..	295,989	345,495	357,424	11,952	13,489	13,200
<b>IMPORTS</b>							
Alumina . . . . .	tons	2,972	3,202	17,556	504	686	1,701
Aluminium, refined ingots . . . . .	..	11,160	1,056	323	5,437	716	295
Asbestos . . . . .	short tons	59,962	65,447	79,015	7,628	8,572	10,705
Diamonds—							
Gemstone . . . . .	m carat	35,526	33,826	49,847	5,246	5,447	6,573
Industrial . . . . .	..	461,321	963,226	744,802	2,299	3,626	3,106
Gold—							
Unrefined bullion(c) . . . . .	fine oz	114,276	129,287	103,254	4,075	4,146	3,146
Refined . . . . .	..	4,109	62,230	8,167	143	2,389	232
Ferro-alloys . . . . .	tons	22,188	30,589	37,243	5,316	12,748	11,660
Nickel—pig, ingot anodes . . . . .	..	1,784	1,466	2,104	3,554	5,372	8,781
Petroleum oils—							
Crude . . . . .	m gal	4,297	4,179	2,297	174,792	163,901	89,872
Enriched crude and other refinery feedstock . . . . .	..	874	918	714	39,453	38,883	31,453
Gasolines and solvents . . . . .	'000 gal	147,578	227,011	245,965	13,457	22,066	22,723
Kerosene . . . . .	..	30,542	37,171	44,490	3,309	3,891	4,482
Automotive distillate, industrial and marine diesel fuels and heavy distillate, n.e.i. . . . .	..	54,421	75,600	126,561	4,336	5,577	8,640
Residual oils . . . . .	..	137,431	265,711	360,413	5,668	10,208	16,607
Lubricating oil . . . . .	..	10,821	8,689	12,520	3,407	2,973	3,979
Phosphate rock . . . . .	'000 tons	3,177	2,746	2,074	31,606	27,875	22,174
Potassium fertilisers . . . . .	tons	134,933	127,347	150,847	3,457	3,432	4,793
Sulphur . . . . .	..	394,987	427,300	269,024	15,434	10,786	4,906
Tin, refined . . . . .	..	143	103	117	415	347	376
Titanium oxide (pigments) . . . . .	..	1,192	1,110	750	480	443	389

(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) Australian produce. (c) Gold content.



Considerable quantities of metallic ores, concentrates, slags, and residues are exported from Australia for refining overseas. The following table shows the quantities of selected items exported during 1969-70 and 1970-71 and their principal metallic content as estimated by assay.

**PRINCIPAL METALLIC CONTENTS OF SELECTED ORES AND CONCENTRATES  
ETC., EXPORTED FROM AUSTRALIA, 1969-70 AND 1970-71**

<i>Ores and concentrates, etc.</i>	<i>Metallic contents—estimated from assay</i>									
	<i>Copper</i>	<i>Lead</i>	<i>Zinc</i>	<i>Tin</i>	<i>Iron</i>	<i>Man- ganese</i>	<i>Tungstic oxide(a)</i>	<i>Gold</i>	<i>Silver</i>	
<b>1969-70</b>										
	tons	tons	tons	tons	'000 tons	tons	units	fine oz	'000 fine oz	
Copper concentrate . . . . .	12,578	..	..	156	..	..	..	40,929	64	
Blister copper . . . . .	7,863	..	..	..	..	..	..	60,235	41	
Copper matte, slags, etc.(b) . . . . .	2,889	6,802	..	1	..	..	..	22	287	
Lead concentrate . . . . .	1,725	76,759	9,191	..	..	..	..	25,774	2,941	
Lead-silver bullion . . . . .	1	164,996	..	..	..	..	..	..	12,182	
Lead slags and residues . . . . .	293	1,895	95	57	..	..	..	..	26	
Zinc concentrate . . . . .	..	3,475	218,470	..	..	..	..	..	365	
Zinc slags and residues . . . . .	10	3	3,445	..	..	..	..	..	..	
Tin concentrate . . . . .	5	4	..	3,657	..	..	..	..	..	
Iron ore—	..	..	..	..	3,303	..	..	..	..	
Pellets . . . . .	..	..	..	..	4,749	..	..	..	..	
Fines . . . . .	..	..	..	..	13,297	..	..	..	..	
Lump . . . . .	..	..	..	..	..	..	..	..	..	
Manganese ore . . . . .	..	..	..	..	..	293,891	..	..	..	
Scheelite concentrate . . . . .	..	..	..	..	..	..	99,420	..	..	
Wolfram concentrate . . . . .	..	..	..	..	..	..	65,518	..	..	
<b>Total metallic content . . . . .</b>	<b>25,364</b>	<b>253,934</b>	<b>231,201</b>	<b>3,871</b>	<b>21,349</b>	<b>293,891</b>	<b>164,938</b>	<b>126,960</b>	<b>15,907</b>	
<b>1970-71</b>										
Copper concentrate . . . . .	32,919	..	..	107	..	..	..	27,025	223	
Blister copper . . . . .	6,831	..	..	..	..	..	..	54,467	40	
Copper matte, slags, etc.(b) . . . . .	2,920	4,213	27	..	..	..	..	23	212	
Lead concentrate . . . . .	1,282	54,316	5,442	..	..	..	..	137,301	1,920	
Lead-silver bullion . . . . .	184	175,796	..	..	..	..	..	4	9,633	
Lead slags and residues . . . . .	188	2,015	37	17	..	..	..	..	11	
Zinc concentrate . . . . .	..	2,235	197,964	..	..	..	..	..	78	
Zinc slags and residues . . . . .	..	..	4,068	..	..	..	..	..	..	
Tin concentrate . . . . .	4	5	..	2,690	..	..	..	..	..	
Iron ore—	..	..	..	..	3,634	..	..	..	..	
Pellets . . . . .	..	..	..	..	8,503	..	..	..	..	
Fines . . . . .	..	..	..	..	18,567	..	..	..	..	
Lump . . . . .	..	..	..	..	..	..	..	..	..	
Manganese ore . . . . .	..	..	..	..	..	318,850	..	..	..	
Scheelite concentrate . . . . .	..	..	..	..	..	..	84,585	..	..	
Wolfram concentrate . . . . .	..	..	..	2	..	..	66,766	..	..	
<b>Total metallic content . . . . .</b>	<b>44,328</b>	<b>238,580</b>	<b>207,538</b>	<b>2,816</b>	<b>30,704</b>	<b>318,850</b>	<b>151,351</b>	<b>218,820</b>	<b>12,117</b>	

(a) 1 unit = 22.4 lb.

(b) 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, 1966-67 TO 1970-71**

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

Detail	Units	1966-67	1967-68	1968-69	1969-70	1970-71
<b>METALS(a)</b>						
<b>Aluminium—</b>						
Australia . . . . .	\$A-ton	520.00	520.90	538.00	564.90	578.00
United States . . . . .	USc-lb	24.7	25.1	26.4	27.9	29.0
<b>Copper—</b>						
Australia . . . . .	\$A-ton	1,048.30	1,132.10	1,126.50	1,500.10	1,087.40
London Metal Exchange	£Stg-tonne	(b)431.7	(b)511.5	(b)516.7	671.8	477.7
<b>Lead—</b>						
Australia . . . . .	\$A-ton	228.80	210.00	234.30	283.50	262.40
London Metal Exchange	£Stg-tonne	(b)85.1	(b)92.0	(b)109.3	132.2	114.7
United States . . . . .	USc-lb	14.27	13.84	13.46	16.10	14.60
<b>Zinc—</b>						
Australia . . . . .	\$A-ton	265.70	258.00	266.10	291.20	295.70
London Metal Exchange	£Stg-tonne	(b)100.2	(b)105.3	(b)114.0	123.9	121.3
'Producers' . . . . .	Stg-ton	101.9	108.0	115.8	127.3	128.8
United States . . . . .	USc-lb	14.36	13.50	13.84	15.30	15.25
<b>Tin—</b>						
Australia . . . . .	\$A-ton	3,160.00	3,007.80	3,063.20	3,463.80	3,344.90
London Metal Exchange	£Stg-tonne	(b)1,220.0	(b)1,274.9	(b)1,363.6	1,524.6	1,476.7
Straits . . . . .	\$Mal-picul	608.3	577.8	585.6	669.7	643.1
<b>Nickel—</b>						
United Kingdom . . . . .	£Stg-tonne	682.0	837.0	(b)944.0	1,123.7	1,231.1
<b>Gold—</b>						
Premium markets—						
Australia . . . . .	\$A-f oz	(c)	36.42	36.83	33.49	33.76
Overseas . . . . .	\$A-f oz	31.47	32.54	36.17	32.05	31.98
United Kingdom . . . . .	£Stg-f oz	12.6	(d)	41.28	37.40	37.87
<b>Silver—</b>						
United Kingdom . . . . .	Stg new pence-f oz	(e)115.3	(e)195.2	(e)198.6	(e)179.1	70.3

**ORES AND CONCENTRATES**

<b>Tin—</b>						
Australia . . . . .	\$A-ltu	27.21	25.81	25.98	30.90	28.66
<b>Wolfram—</b>						
United Kingdom . . . . .	£Stg-ltu	15.49-16.26	14.75-21.13	18.00-22.50	21.00-38.00	22.80-36.75
<b>Rutile—</b>						
Australia . . . . .	\$A-ton	92-96	88-96	88-124	124-150	145-150
United Kingdom . . . . .	£Stg-tonne	(b)43.79-45.04	(b)43.00-50.00	(b)48.50-66.00	(b)66.00-79.00	74.78-79.72
<b>Ilmenite—</b>						
Australia . . . . .	\$A-ton	8.25-10.00	9.00-10.00	9.00-10.00	9.00-11.00	11.00
United Kingdom . . . . .	£Stg-tonne	(b)7.00-7.25	(b)7.00-9.50	(b)7.50-9.50	(b)7.50-9.50	(b)7.38-11.32
<b>Zircon—</b>						
Australia . . . . .	\$A-ton	47.42-51.42	46-50	42-50	35-47	35-39
United Kingdom . . . . .	£Stg-tonne	(b)25.50-26.92	(b)25.00-30.00	(b)26.25-30.00	(b)25.25-27.75	24.85-28.05

(a) Where a daily price does not actually exist for a commodity, daily prices have been imputed from price data which are available. (b) £Stg per ton. (c) There was no Australian premium market prior to May 1968. (d) Not available owing to break in continuity of series; since April 1968 London Gold Market transactions have been in non-monetary gold only. (e) d Stg per f oz.

Details of monthly prices, and price specifications, relating to each commodity in this table, are contained in each issue of the monthly mimeographed bulletin *Minerals and Mineral Products* (10.19).

## REVIEW OF RECENT DEVELOPMENTS IN THE AUSTRALIAN MINERAL INDUSTRY

Prior to Year Book No. 52 it was customary to include a series of detailed reviews of the principal commodities produced by the Australian mineral industry and recent developments concerning these commodities. However, with the increasing diversification and development of the industry, it has become impractical to continue these reviews in the Year Book and the reader who wishes to obtain information of this kind is referred to *The Australian Mineral Industry—Annual 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 each year. Major developments in the industry, particularly during the last year, are reviewed briefly in subsequent parts of this section.

Expansion of the Australian mineral industry was maintained during 1971, with the preliminary value of mineral production increasing approximately 11 per cent from \$1,447 million in 1970 to approximately \$1,600 million in 1971. The major reasons for this increase in the value of mineral production were a substantial increase in the production of crude oil, mainly from the Bass Strait fields in Victoria, the continued expansion of iron ore mining, and the increased production of bauxite, copper, manganese and nickel. The total value of mineral exports continued to increase, mainly because of the increase in shipments of iron ore, black coal, alumina, bauxite and nickel.

### 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 1971 was a period of continued growth in the industry both in mining and processing as detailed below.

Bauxite production from deposits at Weipa, Queensland, increased to a rate of 7 million tons in 1971 following completion of a further stage in the development of the mine and associated township, and of ore treatment and loading facilities. Production capacity will be increased to 10.5 million tons annually by the end of 1972. Approximately 3 million tons from Weipa were used by the Gladstone, Queensland, alumina refinery in 1971, and the requirements of the small refinery at Bell Bay, Tasmania, are estimated as 120,000 tons yearly; the remaining production is available for export.

Bauxite deposits at Gove, Northern Territory, covering reserves of the order of 250 million tons of ore, are being developed by a consortium of seven Australian and one overseas companies. The consortium plans to construct an alumina plant at Gove by mid-1972 with an initial capacity of 500,000 metric tons per annum, increasing to 1,000,000 metric tons annually by mid-1973.

An agreement was signed in Perth in December 1968 with the Western Australian Government for the development of a bauxite/alumina project in the Admiralty Gulf area. A similar agreement was signed in November 1970 for the establishment of a second bauxite/alumina project based on the Darling Range bauxites, and involving an alumina refinery and port facilities at Bunbury.

### Alumina

Expansion of the alumina refinery at Gladstone, Queensland, was completed by the end of 1968, increasing the capacity of the refinery to 900,000 tons per annum; the plant has since been expanded to 1,275,000 tons yearly and will be increased further to 2,000,000 tons per annum by early 1973. The alumina refinery at Kwinana, Western Australia, was expanded from 817,000 tons to 1,024,000 tons annually by July 1970 and to 1,250,000 tons by the end of 1970. Bauxite supplies for the Kwinana refinery are obtained from deposits 30 miles away at Jarrahdale, Western Australia, the reserves of which are assessed as at least 500 million tons. A new alumina plant was also commissioned at Pinjarra Western Australia, in April 1972, with an initial production capacity of 210,000 tons yearly. Comalco Ltd plans to set up an alumina plant, with a capacity of 1,600,000 tons annually, at Weipa in 1976.

### Aluminium

Operating capacity of the smelter at Kurri Kurri, New South Wales, was steadily increased during 1971, and reached a capacity of 44,600 tons annually. The smelter will be expanded to 90,000 tons as and when the market demands. An aluminium powder and paste plant, capable of supplying the whole of Australia's needs, was commissioned in 1968 at Bell Bay, Tasmania. The capacity of the reduction plant at Bell Bay was increased to 94,000 tons per annum in January 1971. Additional capacity at Port Henry, Victoria, was commissioned in 1969 bringing the smelter's total operating capacity to 90,000 tons yearly. A letter of intent has been received by the Western Australian Government regarding the possible establishment of an aluminium smelter at Kwinana within the next decade.

**Copper**

Copper production at Mount Isa will be increased to 150,000 tons yearly by 1974. The expansion programme provides for a new hoisting shaft, extensions to the existing copper smelter and a new concentrator, as well as enlargement of ancillary facilities.

A new copper-gold ore body is being developed near Tennant Creek, Northern Territory. The first stage of development, which will cost \$21 million, will have an installed mining capacity of 500,000 tons of ore per annum and is scheduled for completion by October 1972.

Since the beginning of 1967 the Australian producers' price has been adjusted regularly to reflect movements in the London Metal Exchange daily settlement price. In the early part of 1971, after reaching 52 cents per pound (\$1,164.8 per long ton) in May, the Australian price eased to 41 cents (\$918.4 per long ton) by late November at which it continued until the end of the year.

**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 1971 to Japan and elsewhere were 52 million tons valued at \$406 million.

Reduced iron ore demand, which resulted from a world-wide steel industry recession during 1971, and particularly because of the cutback in Japanese steel output, has led to the deferment of expansion programmes at Paraburdoo and Mount Whaleback, Western Australia.

The Mount Newman Consortium which had planned to achieve a shipment capacity of 25 million tons per year by March 1972 and 30 million tons per year by September 1972 from its Mount Whaleback operation deferred part of the construction which would result in capacity reaching an upper level of 30 million tons. This part of the expansion programme is to be deferred until sales commitments warrant its completion.

Hamersley Iron Pty Ltd will not commence commercial production at Paraburdoo as early as previously anticipated and its Mount Tom Price deposits are expected to be able to supply all ore required for anticipated demand during 1972. Production capacity at Mount Tom Price has been expanded to 22.5 million tons per year and port capacity at Dampier has been expanded. Production capacity at Paraburdoo is planned to be 15 million tons per year.

Annual production from the Mount Goldsworthy, Western Australia, iron ore project is being increased to 8 million tons by 1973. Production capacity at the existing Mount Goldsworthy mine has been increased and deposits at Shay Gap and Sunrise Hill nearby will be developed.

Construction of facilities for the mining of deposits of limonite at Robe River, Western Australia, commenced in 1970. Exports from the Robe River project are expected to commence in late 1972 and build up to a minimum annual rate of 6.1 million tons of prepared sinter fines and 4.2 million tons of iron ore pellets by 1975.

**Lead and zinc**

Following record mine production of lead and zinc in 1969, resulting from completion of major mine expansion programmes at Mount Isa in Queensland and Broken Hill in New South Wales, output of lead increased marginally in 1970 while output of zinc declined. However, in 1971 output of both metals was cut back well below 1969 levels; mine production of lead in 1971 was 392,400 tons and of zinc 441,100 tons. Production of lead bullion at Cockle Creek in New South Wales and Mount Isa, supplemented by small production from Port Pirie, South Australia, was 157,900 tons in 1971, about 6 per cent lower than in 1970, and production of primary refined lead at Port Pirie was cut back from 177,200 tons in 1970 to 160,700 tons in 1971 in response to weakening demand and oversupply on world markets. Total production of refined zinc from Risdon in Tasmania, Port Pirie and Cockle Creek was also cut back in 1971 to 254,600 tons which was about one per cent lower than the record level of 1970.

Strengthening world markets for lead and zinc should allow producers to return to higher levels of production in 1972. Completion of a programme of expansion at the Rosebery mine in Tasmania and additions to the electrolytic zinc refinery at Risdon will make substantial contributions to zinc production but closure of the South Mine at Broken Hill and a continuation of reduced output of lead bullion at Mount Isa will restrict the growth of lead production. A decision to reduce production of lead bullion at Mount Isa was announced early in 1971 and, at the same time, commencement of one of the two major shafts at the new Hilton Mine in Queensland was deferred until 1973. The Hilton Mine is expected to become a major producer of lead and zinc in the late 1970s.

**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 tons valued at about \$1.7 million; in 1971 exports were 19.8 million tons valued at \$212.3 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 1971, there were six Australian oil fields in production, namely, Moonie and Alton, Queensland; Barrow Island, Western Australia; and Barracouta, Kingfish, and Halibut in the Gippsland Shelf area offshore from Victoria. In addition, a small amount of oil is being produced from the Bennett field and several other wells in the Roma area in Queensland. In 1969 commercial and domestic use of natural gas began in Brisbane, Melbourne and Adelaide and in late 1971, in Perth. The production of crude oil in 1971 from the Australian oil fields was 112,913,893 barrels representing some 60 per cent of the country's requirement of refinery feedstock. The cumulative production of crude oil to 31 December 1971 amounted to \$224.4 million barrels.

In 1971, additional discoveries were made in the Cooper Basin in South Australia at Coonatie, Big Lake and Fly Lake and at Walyering, Rankin, North Rankin, and Scott Reef in Western Australia. The provisional figure for footage drilled in petroleum exploration and development in Australia in 1971 was 760,814 feet which is some 476,521 feet less than the footage drilled in the previous year. About 577,770 feet of the 1971 total was attributed to exploration drilling of which 179,041 feet were drilled offshore. A total of 106 wells were completed in 1971, of which 84 were exploration wells, 15 of them offshore. In comparison with the previous year there was a fall of 16 in the number of exploration wells and a decline of 87 development wells in 1971. The decline which was mostly in development drilling was due to the completion of the drilling in the Halibut, Kingfish and Barrow Island fields with the end of the initial developmental programmes in those fields. There was a drop of 11 in the number of offshore exploratory wells which also made a significant contribution to the fall in drilling activity.

#### **Nickel**

Output from Australia's first major nickel mining operation at Kambalda in Western Australia has grown to more than 30,000 tons of nickel per annum since mining commenced in 1967. Mines at Nepean and Scotia also commenced production in early 1969 and a fourth mine is being developed at Carr Boyd Rocks; all of these mines are located in the Kalgoorlie area. At the end of 1971 the refinery at Kwinana, Western Australia, was producing more than 15,000 tons of nickel metal per annum from concentrates; the remaining concentrates will continue to be exported until further smelting and refining facilities are constructed.

Plans have been drawn for the development of the lateritic nickel deposit at Greenvale in Northern Queensland. Following the successful completion of pilot plant tests, construction of a railway and an ammonia leach treatment plant at Townsville, northern Queensland, were commenced in early 1972. Production of 23,000 tons of nickel oxide sinter per annum could commence during 1974.

#### **Phosphate**

Major deposits of phosphate rock were discovered during 1966 near Duchess and Lady Annie in north-west Queensland. The deposits are large by world standards, and feasibility studies are still in progress. Survey work has finished on a possible railway route between Lady Annie and the Gulf of Carpentaria, 800 miles away. Transport and port facilities will be key factors in determining whether the project is to be undertaken.

