

CHAPTER 27

MINERAL INDUSTRY

Further detailed statistics and information on the subjects dealt with in this chapter are contained in the annual printed bulletins *Non-Rural Primary Industries* issued by this Bureau and in *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*, comprising two parts—Part 1—Quarterly Review and Part 2—Quarterly Statistics. The annual mimeographed statistical bulletins *Mining Establishments* (replacing the former *Mining and Quarrying*), *Mineral Production* (replacing the former *Minerals and Mineral Products*), *Mineral Exploration*, and *Overseas Participation in Australian Mining Industry* 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* is issued also, and other current statistics on mining or mine products are contained in the *Quarterly Summary of Australian Statistics*, the *Monthly Review of Business Statistics*, the *Digest of Current Economic Statistics*, and the *Monthly Bulletin of Production Statistics*.

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 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 minerals, including iron ore, lead, zinc, silver, copper, uranium, nickel, and gold, are contained in the Precambrian rocks of the Australian shield. Smaller deposits of tin, tungsten, tantalum, mica, beryllium, manganese, and cobalt 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 occurrences. Smaller amounts of tin, tungsten, molybdenum, bismuth, antimony, and 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 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.

Mineral sands, another important exception, contain rutile, zircon, ilmenite, monazite, 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 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.

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 numerous prospects in the Roma, Surat and Rolleston areas. Gas reserves are present in the Adavale Basin at Gilmore, and in a dozen or so accumulations in the Cooper Basin in South Australia extending into Queensland. 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 Victoria in the Bass Strait, oil in considerable quantities was discovered in the Kingfish and Halibut fields, 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. 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, Packsaddle, Mudrangie, and gas and oil at Tirrawarra and Moorari. The reservoir rocks are of Permian age. In the Carnarvon Basin, Western Australia, commercial crude oil mainly in the Cretaceous formations, and also to a lesser degree in the Jurassic, was discovered at Barrow Island. Off-shore, significant hydrocarbon shows have been discovered in Lower Cretaceous rocks at Legendre. Further south, in the Perth Basin, natural gas in commercially significant quantities was discovered in the Yardarino, Gingin, Dongara and Mondarra prospects, the reservoir rocks being of Lower Jurassic, Lower Triassic and Permian ages. In the off-shore Bonaparte Gulf Basin high pressure natural gas was encountered at the Petrel prospect. In the Amadeus Basin, Northern Territory, natural gas was discovered in commercial quantities in formations of Ordovician age at Mereenie and Palm Valley. 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.

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	Barite Bauxite Cadmium Coal (black) Copper Gold Gypsum Iron ore Lead	Beryl Talc Tantalite	

RESERVES OF MINERALS: AUSTRALIA—*continued*

<i>Production</i>	<i>Reserves adequate</i>	<i>Reserves uncertain</i>	<i>Reserves negligible</i>
Production sufficient for domestic demand and exports	Bismuth Manganese ore (metallurgical) Mineral sands(a) Nickel Opal Salt Silver Tin Tungsten Zinc	Glass sands Antimony	
Production sufficient for domestic demand	Clays (except light grade china clay) Coal (brown) Dolomite Felspar Limestone	Sillimanite	
Production not sufficient for domestic demand	Asbestos (chrysotile) Lithium minerals Phosphate rock Sulphides (as source of sulphur)	Abrasives Bentonite China clay Chromite Cobalt Diatomite Fluorite Magnesite Manganese ore (chemical) Mercury Mineral pigments Petroleum Platinum	Molybdenum
Production nil	Magnesium Potassium salts Vanadium	Arsenic Asbestos (crocidolite) Diamonds Graphite Vermiculite	Borates Nitrates Sulphur

(a) Ilmenite, monazite, rutile, zircon.

Individual minerals

Aluminium. As a result of recent discoveries at Weipa, Gove, in the Darling Range, and in the Kimberley area, 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 exceed 800 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. A table showing Australian coal reserves is published in Year Book No. 53, page 1065.

Copper. The principal deposit of this metal is at Mount Isa, where ore reserves were estimated at 120 million tons in 1970. Other important deposits are situated at Cobar, New South Wales, Mount Morgan, Queensland, Mount Lyell, Tasmania 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 and Halibut fields in the off-shore Gippsland Shelf area in Victoria commenced production in 1969 and 1970 respectively. Production from the nearby Kingfish field commenced in April 1971. At the end of 1970, recoverable reserves in Australia were estimated to be 1,749 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 7.2 million tons in 1970, with a gold content of 4.05 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 17.1 million tons assaying 11 per cent lead and 11 per cent zinc. Reserves at another major producing mine, Mount Isa in Queensland, are 52 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 9.3 million tons, 6 per cent lead and 18 per cent zinc) is being increased. Definite proposals for the development of McArthur River in Northern Territory (reserves of 200 million tons, 4 per cent lead and 9 per cent zinc) have not yet been announced. During 1970, a new deposit was discovered at 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.

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 corner of Western Australia. 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 and Roma fields. Total daily gas production at the end of 1970 was of the order of 170 million cubic feet. To these commercial fields must be added the significant discoveries at Yardarino, Gingin, Dongara and Mondarra in Western Australia where reserves are estimated at 500 U.S. billion cubic feet and the reserves of 1.6 U.S. trillion cubic feet at Mereenie and Palm Valley in the Northern Territory. At the end of 1970, the total reserves of natural gas in Australia, excluding Papua and New Guinea, were estimated at 13.8 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 Dutson 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 fuel on the producing fields. At the end of 1970, reserves of natural gas liquids in Australia, excluding Papua and New Guinea, were estimated to be 274 million barrels.

Nickel. In the Kalgoorlie region of Western Australia a number of nickel sulphide ore bodies have been discovered since 1966. Reserves contained in more than 14 separate ore bodies total more than 27 million tons averaging 3 per cent nickel. Large lateritic nickel deposits have been discovered at Greenvale and Marlborough in Queensland; plans to develop the Greenvale deposits were announced in early 1970.

Phosphate. Accelerated search for phosphate rock commencing in late 1964 resulted in the discovery of major deposits in north-west Queensland in 1966. Detailed assessment and feasibility studies have yet to be completed.

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

Tungsten. The main deposits of tungsten ores are in north-eastern Tasmania (wolfram) and on King Island (scheelite). Australia's own requirements are small, and production is principally for export.

Uranium. In 1967, the Minister for National Development announced a partial embargo on exports of uranium from Australia, which was designed to conserve known resources while encouraging exploration for new deposits. The policy represented a liberalisation of former policies in that prospecting companies were given an assurance in advance that approval would be given to export specified quantities of uranium from existing or newly discovered deposits, depending on their size and date of discovery. Stated reserves amounted to 11,620 short tons of uranium oxide reasonably assured and a further 3,230 short tons possible but not proven; of these reserves, 10,660 short tons were said to be economically recoverable within the price range \$5 to \$10 per pound and 4,190 short tons economically recoverable within the price range \$10 to \$30 per pound. A marked increase in exploration activity following the relaxation of export restrictions has resulted in several important discoveries. At Mary Kathleen in north-west Queensland, an extensive programme of diamond drilling is reported to have significantly extended previously known reserves, while at Westmoreland also in north-west Queensland a preliminary assessment of recently discovered deposits suggests that total reserves could exceed those at Mary Kathleen. 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. As a result of these important discoveries, quantitative restrictions on exports were lifted in February 1971. Other important areas of exploration are Mount Painter and Lake Frome in South Australia, Rum Jungle and South Alligator River in the Northern Territory and the Kimberley region of Western Australia.

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. The Queensland Parliament passed a new Mining Act in 1968 which was simpler but more suited to modern conditions than the *Mining Acts* 1897 to 1967. At April 1971 the 1968 Act had not been brought into operation. In March 1971 a new Mining bill was introduced into the South Australian Parliament for the same purpose but at April 1971 had not been passed.

The following table sets out particulars of the areas occupied under mining Acts and Ordinances in the several States and Territories at 31 December 1966 to 1970. These figures exclude data relating to exploration licences, etc., covering the large areas referred to in the next section below. Also excluded are areas occupied under petroleum exploration and development titles, particulars of which are shown in the table on page 902.

AREAS OCCUPIED UNDER MINING ACTS AND ORDINANCES(a)
STATES AND NORTHERN TERRITORY, 31 DECEMBER 1966 TO 1970
(^{'000} acres)

Year	N.S.W.(b)	Vic.	Qld(c)	S.A.(b)	W.A.	Tas.	N.T.(b)	Total
1966 . .	1,083	84	2,591	97	343	54	36	4,289
1967 . .	1,177	74	2,304	98	372	60	37	4,121
1968 . .	1,146	615	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	4,512	60	97	12,172

(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, and shall be deemed always to have been, 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 and 997.

Off-shore. The *Petroleum (Submerged Lands) Act 1967* 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 this page. 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 1966 to 1970.

**AREAS OCCUPIED UNDER PETROLEUM EXPLORATION AND DEVELOPMENT
TITLES: STATES AND NORTHERN TERRITORY, 31 DECEMBER 1966 TO 1970**

('000 acres)

Year	N.S.W.(a)	Vic.	Qld	S.A.(a)	W.A.	Tas.	N.T.(a)	Total
1966 . . .	113,276	31,174	389,252	237,649	429,994	34,800	239,519	1,475,664
1967 . . .	83,893	32,348	252,213	240,791	426,107	37,979	221,666	1,294,997
1968 . . .	96,522	37,585	297,671	207,260	317,497	34,905	99,505	1,090,945
1969 . . .	88,174	36,636	269,150	212,188	298,888	37,433	74,472	1,016,941
1970 . . .	72,430	31,528	370,603	206,862	n.a.	37,433	39,375	n.a.

(a) At 30 June.

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, 1965-66 TO 1969-70

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	1965-66	1966-67	1967-68	1968-69	1969-70
New South Wales(a)	24,790,851	16,806,842	11,685,378	9,795,466	13,557,543
Victoria(b)	546,117	597,639	662,820	(c)687,429	(c)2,735,721
Queensland(a)	1,293,150	2,354,874	1,843,651	1,687,603	3,038,539
South Australia	985,560	1,091,582	1,036,552	1,254,295	1,556,721
Western Australia	478,294	2,639,894	6,237,593	11,000,716	15,700,090
Tasmania(d)	72,752	86,958	87,413	(e)251,319	(e)423,546
Northern Territory	88,728	110,597	290,810	283,382	449,362
Commonwealth	6,021	10,126	8,729	(c)11,232	(c)491,656

(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 next page.

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 the Territory of Papua and 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 the Territory of Papua and 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 the Territory of Papua and 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 the Territory of Papua and 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 Territory 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 1966 to 1970 are shown in the table on page 907.

Various amendments to the Act have altered the amount of subsidy and the type of operations to which a subsidy is applicable. The most recent amendment in 1969, provides for the payment of subsidy for approved operations completed before 30 June 1974. On-shore operations, both exploration drilling and geophysical, are subsidised at the rate of 30 per cent of approved costs. 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 \$A2.69 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 the Territory of Papua and 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 \$A3.14 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

	1.36
plus weighted average overseas freights as at 10 October 1968	0.46
Wharfage and other charges as at 10 October 1968	0.07

	1.89
less a deduction for coastal freight	0.09

	1.80

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 for ten years. 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 the Territories of Papua and 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 and 1965.

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 \$8 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 July 1968, reduced by seventy-five per cent of the amount of the excess. Prior to 1 July 1968 subsidy was reduced by the full amount 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 1966 to 1970 are shown in the table on page 907.

Assistance to the copper mining industry. After a Tariff Board investigation, assistance was accorded to the industry in 1958, partly by import duty and partly by bounty. Under the *Copper Bounty Act 1958-1966*, bounty was payable when the overseas price was \$580 per ton or less and at a reduced rate up to a price of \$650 per ton on refined copper for use in Australia. The Act lapsed on 31 December 1966. The import duty continues in operation, for imposition when the overseas price of copper falls below \$580 a ton.

Assistance to the producers of sulphuric acid and iron pyrites. Following recommendations of the Tariff Board, the *Sulphuric Acid Bounty Act 1954* was extended to 30 June 1965, and then to 31 December 1970. Similarly, the *Pyrites Bounty Act 1960* was enacted to operate to 30 June 1965, and it too was extended to 31 December 1970. 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 1966-1970 are shown in the table on page 907.

Payments to producers of phosphate fertilisers. The *Phosphate Fertilisers Bounty Act 1963-1969* provides for a bounty to be paid on superphosphate and ammoniated phosphate fertilisers manufactured and used in Australia. (This includes approved trace elements, compounds or substances when added to superphosphate). Bounty is payable on the fertiliser value of superphosphate, as measured by its soluble content of phosphorus pentoxide. A standard grade of superphosphate containing approximately 20 per cent soluble content of phosphorus pentoxide qualifies for full bounty of \$12 per ton. If the phosphorus pentoxide content is outside the range of 19.5 to 20.5 per cent, bounty is payable at \$60 per ton of contained phosphorus pentoxide. This same rate is payable on the phosphorus pentoxide content of ammonium phosphate. Bounty on 'double' and 'triple' grade superphosphates is payable in accordance with the phosphorus pentoxide content.

The intention of this Act is to assist consumers of superphosphate (primary producers). The Act is due to expire on 31 October 1971. Payments under the Act, for the years 1966-1970 are set out in the following table.

**COMMONWEALTH GOVERNMENT PAYMENTS TO THE MINERAL
INDUSTRY: AUSTRALIA, 1966 TO 1970**

(\$'000)

Year	Petroleum exploration (a)	Gold mining(b)	Pyrites mining(c)	Sulphuric acid production (d)	Phosphate fertiliser production (e)
1966 . . .	10,154	3,784	288	1,398	25,818
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

(a) *Petroleum Search Subsidy Act 1959-69*. Includes payments in the Territory of Papua and New Guinea: see also the table on page 938. (b) *Gold-Mining Industry Assistance Act 1954-1968*. Includes payments in the Territory of Papua and New Guinea. (c) *Pyrites Bounty Act 1960-1969*. (d) *Sulphuric Acid Bounty Act 1954-1969*. (e) *Phosphate Fertilisers Bounty Act 1963-1969*.

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 are professional. The budget for the financial year 1970-71 was \$17.8 million, of which \$10.3 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 909 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 1969-70 amounted to \$451,200 including \$138,295 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, on-shore and off-shore, 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 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 miners' ores. The Tennant Creek battery is currently cyaniding the gold in accumulated tailings while the Mount Wells battery is crushing parcels of tin ores and small quantities of gold, lead, copper, and wolfram ores. The crushing charges are subsidised by government grants. In addition, the Administration provides cartage subsidies and financial advances to encourage miners to carry out mining operations. Assistance is also given to the industry by drilling encouraging prospects. Roads and water supply services are provided and maintained for mines under active development throughout the Territory.

Research

Research investigations into problems of mining, ore-search, ore-dressing and metallurgy are conducted by Governmental 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 910). 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 geophysical 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 a new Section of Mineral Physics. The laboratories are located in Melbourne, Sydney, Perth and Canberra. Current research programmes include:

- (a) Exploration, which aims to increase the efficiency of mineral exploration procedures by studying the ways in which mineral deposits form, and by improving and developing techniques whereby new ore bodies can be located and delineated. This includes projects on nickel mineralisation, veins and lodes, stratiform ores, hydrocarbons, geochemistry, geophysics, and borehole logging.
- (b) Processing and utilisation, which seeks to improve the efficiency of the mining, upgrading, metal extraction and utilisation of Australian ores, and to contribute to the efficient utilisation of Australian fossil fuels. This incorporates work on comminution, physical concentration, flotation, pyrometallurgy, hydrometallurgy, electrometallurgy, mineral sands, iron ores, coal assessment, coal usage, natural gas, gas cleaning, sulphide reactivity and fluidisation.
- (c) Support Studies, to provide an extension of knowledge in areas of present and anticipated mineral interests. In addition to planning and development activities, these cover structure of solids, surface properties, rock physics, sulphide mineralogy, ore-forming solutions, reaction mechanisms and kinetics, thermodynamics, process control, halide metallurgy, non-metallic minerals and general chemical engineering studies.

A significant proportion of the research is supported with funds provided by the industry. The definition of research needs is being examined in co-operation with the Australian Mineral Industries Research Association.

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 are 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 immediate problems. Private industry has formed the Australian Mineral Industries Research Association, which is composed of fifty-eight members representing a large proportion of the mining, metallurgical and related companies operating in Australia at present. It was set up in 1959, chiefly to represent private industry in the management of the Australian Mineral Development Laboratories, but the Association now finances other research work into geology, mining and ore-dressing at Universities, C.S.I.R.O., and the Australian Mineral Development Laboratories. Expenditure for the year 1969-70 was \$301,778.

In addition, the Association provided \$50,000 to the Australian Mineral Development Laboratories towards the cost of a new building (the second of four such payments) and an advance of \$26,000 to International Technical Services Limited. The latter is a new non-profit consulting company jointly owned by the Association and Battelle Memorial Institute, Columbus, U.S.A. and associated with the Australian Mineral Development Laboratories.

The Australian Coal Industry Research Laboratories were commissioned by private enterprise to carry out research to a value of \$800,800 in the financial year 1969-70, with a further \$40,000 being provided by the Joint Coal Board. These laboratories have been commissioned by four major coal producing groups in New South Wales to carry out work on coal mining strata problems to a value of \$100,000 over the two years 1970-71 and 1971-72, as recommended by the Coal Industry Technical Advisory Committee.

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 International Tin Agreement, which came into force provisionally on 1 July 1961 and definitively on 21 February 1962.

This Agreement was for a period of five years and had the following objectives:

- (a) to prevent or alleviate widespread unemployment or under-employment and other serious difficulties likely to arise from maladjustments between the supply and the demand for tin;
- (b) to prevent excessive fluctuations in the price of tin and to achieve a reasonable degree of stability of price;
- (c) to ensure adequate supplies of tin at prices which are fair to consumers and provide a reasonable return to producers; and
- (d) to provide a framework for the consideration of measures to promote the progressively more economic production of tin, while protecting deposits of tin from unnecessary waste or premature abandonment, thus facilitating expansion in world consumption of tin; and to keep under review the long-term need for the development of new deposits of tin.

The Third International Tin Agreement, which came into force provisionally on 1 July 1966 and definitively on 21 March 1967, contains several additional objectives:

- (a) to ensure conditions which will help achieve a dynamic and rising rate of production of tin on the basis of a remunerative return to producers, which will help secure an adequate supply at prices fair to consumers and which will help provide a long-term equilibrium between production and consumption;
- (b) in the event of a serious shortage of supplies of tin occurring or being expected to occur, to take steps to secure an increase in the production of tin and a fair distribution of tin metal at equitable prices.

Although the framework of the Third Agreement is basically that of the Second, objectives have been broadened in line with the principles of the United Nations Conference on Trade and Development (UNCTAD) and, as such, emphasise the need for expansion of export earnings in the developing countries. Thus the emphasis has been shifted from surplus production and export controls inherent in the Second Agreement to one of increased production in the new Agreement.

The Agreement is operated by the International Tin Council, which is made up of the following Governments: Australia, Austria, Belgium, Bolivia, Canada, Czechoslovakia, Democratic Republic of the Congo, Denmark, France, India, Indonesia, Italy, Japan, Korea, Malaysia, Mexico, Netherlands, Federation of Nigeria, Spain, Thailand, Turkey, United Kingdom. Member Governments participate as producing or consuming countries. 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. 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. The buffer stock was established with contributions from producing countries, equivalent to 10,000 long tons of metal, wholly made in cash at £stg1,000 per long ton; a further £10 million remains on call from the producer members and a standby-credit facility of £10 million from a consortium of banks. The original buffer stock price range under the Third Agreement was: ceiling £1,400—must sell; £1,300 to £1,400—may sell; £1,200 to £1,300—no action; £1,100 to £1,200—may buy; floor £1,100—must buy. However, following devaluation of sterling, the buffer stock price range was adjusted to the following limits: £1,630—must sell; £1,515 to £1,630—may sell; £1,400 to £1,515—no action; £1,280 to £1,400—may buy; £1,280—must buy.

On 18 September 1968 the International Tin Council declared the period 19 September 1968 to 31 December 1968 to be a period of export control. The total permissible export amount during that period for the six producing members in the agreement, Bolivia, Congo D.R., Indonesia,

Malaysia, Nigeria, and Thailand, was 42,950 long tons. The quotas established for the producer members represented a moderate cut, in effect some 4 per cent on exports in the second quarter of 1968. The Council also addressed an invitation to the Australian Government, asking that Australia limit its exports of tin to the same degree and for the same period as the producer members of the Agreement. The Australian Government introduced export controls on tin and tin concentrates as from 6 December 1968. Export restrictions on tin were lifted in early December 1969.

Australia has signed the Fourth International Tin Agreement, which was negotiated at Geneva in April/May 1970 and will come into operation as from 1 July 1971, for a period of five years. Legislation was introduced into Parliament on 1 April 1971 to ratify Australia's participation in the Agreement. Australia will be joining the Fourth Agreement as a 'producing' (i.e. exporting) member, whereas in past Agreements our status has 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. An initial contribution equivalent to 7,500 tons of tin metal will be subscribed on entry into force of the Agreement. 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 current (Third) Agreement. 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.

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, 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

This section contains statistics of the mining industry for all States and Territories and Australia obtained from the Mining Census taken in respect of the year ended June 1969. This latest census differs from previous censuses for reasons given below, and therefore the statistics obtained from it are not strictly comparable with statistics of the mining industry which have been published for previous years. For this reason the two sets of data are presented separately, the 1968-69 data appearing first, and the run of years data following.

In 1968 and earlier years, 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.

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.

The economic censuses of Mining, Manufacturing, and Retail Trade previously conducted in Australia were originally designed and subsequently developed primarily to provide statistics for particular industries on a basis which would best suit the requirements of users interested in statistics of those industries. More recently there has been a growth of interest in statistics describing activity in the economy as a whole—reflected, for example, in the development of employment and earnings statistics, surveys of capital expenditure and stocks and the whole field of national accounts statistics. For such purposes statistics derived from economic censuses in the past have had serious limitations despite the fact that they covered a broad area of the whole economy. Because of the special-purpose nature of each of the censuses, there were no common definitions of data, there was no common system of reporting units, and, as a standard industrial classification was not used for these censuses, industry boundaries were not defined in ways which would avoid overlapping, or gaps occurring between the industrial sectors covered. For these reasons, direct aggregation and comparison of statistics from different censuses were not possible.

The integration of these economic censuses meant that for the first time they were being collected on the basis of a common framework of reporting units and data concepts and in accordance with a standard industrial classification. As a result, the statistics for the industries covered by the censuses are now provided with no overlapping or gaps in scope, and in such a way that aggregates for certain important economic data such as value added, employment, salaries and wages, fixed capital expenditure and stocks can be obtained on a consistent basis for all sectors of the economy covered by the censuses.

For the integration of the various censuses it was necessary to undertake three major developments:

- (a) The census units for which the statistics were to be collected (mines, factories, shops etc) had to be defined and identified in consistent ways and recorded in a central register, together with identifying data about the businesses owning and operating them.
- (b) A standard industrial classification had to be adopted so that the census units could be classified in consistent ways and to enable the boundaries of the economic censuses to be determined without gaps or overlapping between them.
- (c) In order to bring the items of data to a consistent basis of definition in all censuses, it was necessary to revise all the forms used in previous censuses.

The standardisation of census units in the integration of economic censuses means that the basic census unit (the establishment), in general, now covers all the operations carried on under the one ownership at a single physical location. The mining establishment is thus one predominantly engaged in mining, but the data supplied for it now cover (with a few exceptions) all activities at the location. Previously, the mining establishment covered only mining activities, including the dressing or beneficiation of ores or other minerals. It now covers, in addition, subject to certain exceptions mentioned below:

- (a) Any activities connected with the selling and distribution of the minerals produced and
- (b) Any non-mining activities (e.g. manufacturing, construction).

The exceptions in general relate to locations where the subsidiary activities (in terms of gross value) exceed one million dollars, which are treated for statistical purposes as two or more establishments corresponding to the various kinds of activity carried on.

The establishment statistics (other than the number of establishments) also include data relating to separately located administrative offices and ancillary units serving the establishment, and forming part of the business (enterprise) which owns and operates the establishment. These units, such as head offices, storage premises, etc., were formerly excluded from the mining census.

The application of the definition of standardised census units, as set out above, has resulted in the exclusion of a number of units covered by mining censuses in the past. Previous censuses covered, broadly, all mining carried out at locations held under mining leases, and quarrying activities, irrespective of whether mining or quarrying was the predominant activity at the location. However, from 1968-69, if mining (or quarrying) is not the predominant activity the establishment is not classified

to mining and is not covered by the mining census. For example, where mining at an establishment is subsidiary to an activity covered by one of the other integrated censuses, such as clay mining at a brick manufacturing establishment, data on the mining operations are included in the manufacturing census as part of the whole activities of that establishment.

In addition to those mining operations excluded by the application of the definition of the census unit, itinerant and part-time miners have now been omitted because of their limited scale of operations and consequent difficulties in collecting census returns for them. Previously, data in respect of this category of mining were estimated and included in the Mining Census results.

As a result of these changes, the 3,546 large and small mines and quarries for which data were collected, or estimated, in the 1968 census have been reduced to 1,716 mining establishments in the 1968-69 census. Itinerant and part-time miners in the metallic, construction materials, and other non-metallic sub-divisions account for a large proportion of this reduction. The rest of the reduction results from establishments at which the mining activity is subsidiary to some other activity at the same location being classified outside the mining division. This category mainly affects the other non-metallic (such as clay mining and limestone quarrying) and construction materials sub-divisions.

The Australian Standard Industrial Classification (ASIC), described in the publication *Australian Standard Industrial Classification (Preliminary Edition)*, 1969, Vol. 1, defines the industries in the economy for statistical purposes, thus permitting the scope of the different economic censuses to be specified without any gaps or overlapping between them. It also sets out standard rules for identifying the statistical units (e.g. establishments) and for coding them to the industries of the classification. This classification is broadly convertible to the International Standard Industrial Classification adopted by the United Nations Statistical Commission. The adoption of the ASIC has resulted in changes in scope between the 1968-69 economic censuses and the individual economic censuses conducted in previous years. However, in the case of the mining census, which covers the whole of the mining division of the ASIC except for mineral exploration and other services to mining, the main change from previous censuses is the inclusion of briquetting establishments and natural gas absorption or purifying plants.

The third step in integrating the censuses, whereby the items of data on the census forms were standardised for all census sectors, has meant changes in the content of the statistics. For example, the value of "turnover" is now collected instead of the value of output at the mine, and purchases and selected expenses are collected as well as the value of specified materials, fuels, etc., used. However, the underlying concept of 'value added' is similar to the former concept 'value of production', even though its method of derivation is different. Value added, the basic measure of the establishment's contribution to total production, is now calculated as turnover* less purchases and transfers in (from other establishments of the enterprise), plus increase (or less decrease) in stocks. In the past the corresponding item, value of production, was obtained by deducting the value of materials, fuels, etc. used from the value of output at the mine. A detailed comparison of the method of derivation is shown under *Value added* on page 918.

Even though the concept of value added is similar to value of production, direct comparison of 1968-69 and 1968 figures will not be possible because of the change in census units already mentioned, which has resulted in the value added for the whole establishment's activities being reported (not merely the value added for the mining activity), and in the omission of value added by mining activities in establishments classified outside the mining division. Comparison is also affected, of course, by the changes in the scope of the mining census due to the adoption of ASIC, and by the rectification of certain deficiencies in coverage (and of data reported) in the censuses for earlier years. A further factor is that a different valuation, estimated on the basis of commercial prices, has been placed on minerals produced by enterprises for their own consumption in Australia.

As mentioned above, the value of 'turnover' (including the value of sales and transfers out) is now collected in the mining census in lieu of the value of output at the mine published for 1968 and earlier years. It should be noted, however, that statistics of the value of output at the mine of mineral production continue to be compiled for all establishments, including those classified outside the mining division. These values of output for 1968-69 are included in the section *Mineral production* on page 923.

The change in the census period from year ended 31 December to 30 June means that the 1968-69 census figures overlap the 1968 census results in regard to the period July to December 1968. However, it is not possible to distinguish the precise extent of this overlap due to the innovations in regard to census units and industrial classification mentioned above.

* In this sub-section 'sales transfers out and other operating revenue' appears instead of 'turnover', as two components of turnover have been omitted from the preliminary statistics which are shown for 1968-69. These are 'capital work done for own use' and 'bounties and subsidies on production'.

The statistics in this sub-section are preliminary and subject to revision. While the industry classification of mining establishments, and the adjustment to a consistent basis of the value of transfers between establishments of the same enterprise, have been substantially completed, both are subject to final confirmation. For these reasons, only key items of data are presented for broad industry groups. The first table shows these key items for Australia. Each following table shows statistics for a particular item for all States and Territories and Australia, preceded by an explanation of the item.

**MINING ESTABLISHMENTS: SUMMARY OF OPERATIONS, BY INDUSTRY SUB-DIVISION
AUSTRALIA 1968-69**

Industry sub-division	ASIC code(a)	Number of establishments operating during 1968-69	Persons employed(b)			Wages and salaries	Sales, transfers out and other operating revenue	Stocks at 30 June		Purchases, transfers in and selected expenses	Value added
			Males	Females	Total			1968	1969		
		No.	No.	No.	No.	\$m	\$m	\$m	\$m	\$m	\$m
Metallic minerals	11	343	25,923	1,261	27,184	116.8	640.8	58.4	71.8	223.4	430.8
Coal	12	152	19,068	274	19,342	92.8	333.0	27.6	29.4	130.6	204.3
Crude petroleum including natural gas	13	9									
Construction materials	14	870	6,560	428	6,988	24.5	121.0	9.4	10.1	46.2	75.6
Other non-metallic minerals	15	342	1,707	74	1,781	5.7	33.7	2.6	3.0	15.6	18.6
Total mining, excluding services to mining		1,716	53,258	2,037	55,295	239.8	1,128.6	98.1	114.3	415.7	729.2

(a) Australian Standard Industrial Classification; see page 914. (b) At 30 June 1969; includes working proprietors.

Number of establishments

The following table shows the number of establishments which operated during the year 1968-69. 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, 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.
Metallic minerals	11	82	10	111	6	78	41	15	..	343
Coal	12	99	6	40	1	3	3	..	..	152
Crude petroleum including natural gas	13	..	3	4	1	1	..	..	..	9
Construction materials	14	326	206	146	97	51	31	6	7	870
Other non-metallic minerals	15	156	51	31	61	33	10	..	..	342
Total mining, excluding services to mining		663	276	332	166	166	85	21	7	1,716

(a) Australian Standard Industrial Classification; see page 914.

Employment

The statistics of the number of persons employed shown in the following table relate to working proprietors at the end of June 1969 and employees on the payroll of the last pay period in June 1969, including those working at separately located administrative offices and ancillary units in the State. Note that persons employed in each State (and their wages and salaries) relate to those employed at establishments, administrative offices or ancillary units located in the State, even though the administrative offices or ancillary units may have served establishments located in another State.

**MINING ESTABLISHMENTS: MALES, FEMALES AND PERSONS EMPLOYED^(a)
BY INDUSTRY SUB-DIVISION, STATES AND TERRITORIES, 1968-69**

<i>Industry sub-division</i>	<i>ASIC code^(b)</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>
MALES EMPLOYED										
Metallic minerals . . .	11	6,841	2,802	6,223 2,295	877	7,596 676	3,527 (c)	961	..	25,923
Coal . . .	12	13,112								
Crude petroleum including natural gas . . .	13	..	1,865 186	1,026 (c)	652 365	467 186	162 (c)	52	86	6,560 1,707
Construction materials . . .	14	2,250								
Other non-metallic minerals . . .	15	613								
Total mining, excluding services to mining . . .		22,816	4,853	9,861	1,894	8,925	3,810	1,013	86	53,258
FEMALES EMPLOYED										
Metallic minerals . . .	11	234	114	424 58	74	350 12	121 (c)	34	..	1,261
Coal . . .	12	112								
Crude petroleum including natural gas . . .	13	..	161 10	53 (c)	25 16	51 5	3 (c)	1	10	428 74
Construction materials . . .	14	124								
Other non-metallic minerals . . .	15	30								
Total mining, excluding services to mining . . .		500	285	544	115	418	130	35	10	2,037
PERSONS EMPLOYED										
Metallic minerals . . .	11	7,075	2,916	6,647 2,353	951	7,946 688	3,648 (c)	995	..	27,184
Coal . . .	12	13,224								
Crude petroleum including natural gas . . .	13	..	2,026 196	1,079 (c)	677 381	518 191	165 (c)	53	96	6,988 1,781
Construction materials . . .	14	2,374								
Other non-metallic minerals . . .	15	643								
Total mining, excluding services to mining . . .		23,316	5,138	10,405	2,009	9,343	3,940	1,048	96	55,295

(a) At 30 June 1969; includes working proprietors. (b) Australian Standard Industrial Classification; see page 914.
(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 1968-69 (calendar year 1968 for Queensland), 35 persons were recorded as killed and 1,152 as injured in mining (including quarrying) accidents. Recorded deaths and injuries in that year in the metallic minerals industry were 30 and 751, and in the coal mining industry 2 and 275.

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**
(\$ million)

<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>
Metallic minerals . . .	11	32.2	13.7	31.8 12.0	3.9	28.3 2.8	15.4 (b)	5.2	..	116.8
Coal . . .	12	64.2								
Crude petroleum including natural gas . . .	13	..	7.5 0.6	3.2 (b)	2.0 1.3	2.2 0.7	0.5 (b)	0.3	0.4	24.5 5.7
Construction materials . . .	14	8.4								
Other non-metallic minerals . . .	15	1.8								
Total mining, excluding services to mining . . .		106.6	21.9	48.2	7.1	34.0	16.3	5.4	0.4	239.8

(a) Australian Standard Industrial Classification; see page 914. (b) Not available for publication.

Sales, transfers out and other operating revenue

The following table shows 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 excludes rents, leasing revenue, interest, royalties, and receipts from the sale of fixed tangible assets.

MINING ESTABLISHMENTS: SALES, TRANSFERS OUT AND OTHER OPERATING REVENUE, BY INDUSTRY SUB-DIVISION, STATES AND TERRITORIES, 1968-69
(\$ million)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
Metallic minerals . . .	11	130.6	39.8	151.8	57.8	217.0	55.6	33.6	..	640.8
Coal . . .	12	187.0		54.0		38.5	(b)	..	..	333.0
Crude petroleum including natural gas . . .	13	..	40.1	(b)	9.8	11.7	2.3	1.8	1.7		121.0
Construction materials . . .	14	40.4		13.3						3.6		(b)	..	..
Other non-metallic minerals . . .	15	9.4	3.8	(b)	12.2	3.6	(b)	..	..	33.7
Total mining, excluding services to mining . . .		367.4	83.6	231.0	79.8	270.8	59.1	35.3	1.7	1,128.6

(a) Australian Standard Industrial Classification; see page 914. (b) Not available for publication.

Purchases, transfers in and selected expenses

The following table shows purchases of electricity, fuels, stores and other materials, plus transfers in of goods from other establishments of the same enterprise, plus 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
(\$ million)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
Metallic minerals . . .	11	46.8	14.6	48.9	17.2	81.1	18.4	14.1	..	223.4
Coal . . .	12	82.5		23.5		4.5	(b)	..	..	130.6
Crude petroleum including natural gas . . .	13	..	16.7	(b)	3.1	4.0	1.0	0.9	0.7		46.2
Construction materials . . .	14	14.4		5.5						2.4		(b)	..	..
Other non-metallic minerals . . .	15	4.0	1.5	(b)	5.9	2.4	(b)	..	..	15.6
Total mining, excluding services to mining . . .		147.6	32.7	81.6	26.3	92.0	19.8	14.9	0.7	415.7

(a) Australian Standard Industrial Classification; see page 914. (b) Not available for publication.

Stocks

Statistics on the value of stocks at 30 June 1968 and 1969, are shown in the following table. Figures include all the 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 1968 AND 1969
BY INDUSTRY SUB-DIVISION, STATES AND TERRITORIES**
(\$ million)

<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>
STOCKS AT 30 JUNE 1968										
Metallic minerals . . .	11	21.0	} 8.8	{ 8.4 5.5	} 0.9	{ 16.9 3.3	} 7.2 (b)	} 4.3 ..	}	} 58.4
Coal . . .	12	9.4								
Crude petroleum including natural gas . . .	13	..	} 3.1	{ (b) 1.0	} 1.0	{ 0.7 0.2	} 0.2 (b)	} 0.1 ..	} 0.1 ..	} 9.4 2.6
Construction materials . . .	14	3.2								
Other non-metallic minerals . . .	15	0.3	0.4	(b)	1.2	0.2	(b)	..	..	2.6
Total mining, excluding services to mining . . .		34.0	12.4	15.6	3.1	21.1	7.4	4.4	0.1	98.1
STOCKS AT 30 JUNE 1969										
Metallic minerals . . .	11	21.6	} 7.0	{ 11.3 5.7	} 1.7	{ 24.1 4.3	} 8.3 (b)	} 5.1 ..	}	} 71.8
Coal . . .	12	11.8								
Crude petroleum including natural gas . . .	13	..	} 2.2	{ (b) 1.1	} 0.8	{ 1.7 0.3	} 0.3 (b)	} (c) ..	} 0.1 ..	} 10.1 3.0
Construction materials . . .	14	3.8								
Other non-metallic minerals . . .	15	0.5	0.5	(b)	1.2	0.3	(b)	..	..	3.0
Total mining, excluding services to mining . . .		37.6	9.8	19.0	3.6	30.6	8.6	5.1	0.1	114.3

(a) Australian Standard Industrial Classification; see page 914. (b) Not available for publication. (c) Less than \$50,000.

Value added

The following table shows *value added*, calculated as sales, transfers out and other operating revenue, plus increase (or less decrease) in the value of stocks, less purchases, transfers in and selected expenses. Preceding the table is a comparison of the method of derivation used, with the corresponding former concept *value of production*.

<i>Value of production 1968</i>	<i>Value added 1968-69</i>
Selling value at the mine, exclusive of transport costs from the mine to the point of sale, of minerals produced	Sales, and transfers out (to other establishments of the enterprise), of minerals and other goods produced by the establishment, <i>plus</i> Sales and transfers out of minerals and other goods not produced by the establishment, <i>plus</i> Bounties and subsidies on production (a), <i>plus</i> All other operating income, <i>plus</i> Capital work done for own use, for rental or lease(a)
<i>Equals</i> Value of output	<i>Equals</i> value of turnover <i>Plus</i> Value of stocks at 30 June 1969 <i>Less</i> Value of stocks at 30 June 1968
<i>Less</i> Value of power, fuel, light, other materials and stores used in production(b)	<i>Less</i> the sum of Purchases, and transfers in (from other establishments of the enterprise), of electricity, fuels, stores and other materials for use in production Purchases and transfers in of minerals and other goods for resale Charges for commission and contract work Repair and maintenance expenses Outward freight and cartage, motor vehicle running expenses, sales commission payments
<i>Equals</i> Value of production	<i>Equals</i> Value added

(a) Omitted from the following table. not available.

(b) Not deducted for construction materials in N.S.W. where the data were

MINING ESTABLISHMENTS: VALUE ADDED, BY INDUSTRY SUB-DIVISION
STATES AND TERRITORIES, 1968-69

(\$ million)

Industry sub-division	ASIC code(a)	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
Metallic minerals	11	84.4	23.5	105.9 30.7	41.3	143.1	38.3 (b)	20.3	..	430.8
Coal	12	106.9								
Crude petroleum including natural gas	13	26.5	22.5	8.0 (b)	6.5	8.8	1.4	0.9	1.0	204.3
Construction materials	14	26.5								
Other non-metallic minerals	15	5.5	2.3	(b)	6.2	1.3	(b)	..	..	75.6
Total mining, excluding services to mining		223.4	48.3	152.8	54.1	188.2	40.4	21.1	1.0	729.2

(a) Australian Standard Industrial Classification; see page 914. (b) Not available for publication.

Mining industry statistics, 1964 to 1968

Mining industry data for years up to 1968 were obtained from the former annual Mining and Quarrying Census. As explained on pages 912-5, the statistics obtained from the Mining Census taken in respect of the year ended June 1969 are not strictly comparable with these statistics obtained from previous censuses. The statistics in this sub-section are final. Further details of mining industry statistics up to 1968 are contained in pages 920-7 of Year Book No. 56.

Number of mines and quarries

The following table shows the number of mines and quarries which operated in Australia for the years 1964 to 1968.

NUMBER OF MINES AND QUARRIES: AUSTRALIA, 1964 TO 1968

Industry	1964	1965	1966	1967	1968
Metal mining—					
Gold	246	193	179	171	160
Silver-lead-zinc	20	32	30	32	30
Copper-gold	86	75	124	174	214
Tin	371	391	363	393	341
Mineral sands	20	21	23	25	23
Iron	(a)	(a)	11	11	12
Other metal	56	53	52	69	59
Total, metal mining	799	765	782	875	839
Fuel mining—					
Black coal	179	168	158	150	150
Brown coal	7	6	5	5	5
Other fuel	3	3	4	5	5
Total, fuel mining	189	177	167	160	160
Non-metal (excluding fuel) mining(b)	756	802	973	1,098	1,152
Total, all mining	1,744	1,744	1,922	2,133	2,151
Construction material quarrying(b)	1,148	1,234	1,276	1,280	1,395
Total, all mining and quarrying	2,892	2,978	3,198	3,413	3,546

(a) Included in Other metal. (b) Incomplete, owing to difficulties of coverage.

Employment in mining and quarrying

The following table shows the average numbers engaged in the various mining industries in Australia for the years 1964 to 1968. The figures show the average number of persons employed during the whole year, including working proprietors.

MINING AND QUARRYING: EMPLOYMENT(a), AUSTRALIA, 1964 TO 1968

Industry	1964	1965	1966	1967	1968
Metal mining—					
Gold	4,753	4,525	4,447	4,074	3,602
Silver-lead-zinc	7,811	7,269	8,681	9,703	9,490
Copper-gold	2,341	2,312	2,554	2,712	3,016
Tin	1,191	1,402	1,550	1,748	1,544
Mineral sands	1,734	2,000	2,434	2,543	2,694
Iron	(b)	(b)	1,323	1,609	1,999
Other metal	1,348	2,251	972	1,299	1,670
<i>Total, metal mining</i>	<i>19,178</i>	<i>19,759</i>	<i>21,961</i>	<i>23,688</i>	<i>24,015</i>
Fuel mining—					
Black coal(c)	15,364	15,391	15,169	15,448	16,308
Brown coal.	1,673	1,710	1,760	1,677	1,487
<i>Total, fuel mining</i>	<i>17,037</i>	<i>17,101</i>	<i>16,929</i>	<i>17,125</i>	<i>17,795</i>
Non-metal (excluding fuel) mining(d)	2,783	2,795	2,930	2,803	3,433
<i>Total, all mining</i>	<i>38,998</i>	<i>39,655</i>	<i>41,820</i>	<i>43,616</i>	<i>45,243</i>
Construction material quarrying(d)	5,814	6,217	5,957	5,848	6,527
<i>Total, all mining and quarrying</i>	<i>44,812</i>	<i>45,872</i>	<i>47,777</i>	<i>49,464</i>	<i>51,770</i>

(a) Average employment during whole year including working proprietors. (b) Included in Other metal. (c) Includes Other fuel mining. (d) Incomplete, owing to difficulties of coverage.

Salaries and wages paid

Salaries and wages paid in the mining and quarrying industries in Australia during each year 1964 to 1968 are shown in the following table. Information regarding rates of wages paid in the mining industry is shown in Chapter 12 Labour, Wages and Prices (page 245) and also in the *Labour Report*.

MINING AND QUARRYING: SALARIES AND WAGES PAID(a), AUSTRALIA
1964 TO 1968
(\$'000)

Industry	1964	1965	1966	1967	1968
Metal mining—					
Gold	11,812	11,974	12,409	12,591	11,465
Silver-lead-zinc	29,948	34,397	44,651	46,711	49,225
Copper-gold	6,834	7,415	8,205	9,235	10,780
Tin	2,648	3,313	4,156	5,035	5,056
Mineral sands	4,706	5,837	7,673	8,603	10,015
Iron	(b)	(b)	4,917	7,529	9,631
Other metal	4,038	7,241	3,683	5,790	7,372
<i>Total, metal mining</i>	<i>59,986</i>	<i>70,177</i>	<i>85,696</i>	<i>95,495</i>	<i>103,544</i>
Fuel mining—					
Black coal(c)	52,204	55,942	60,191	65,549	75,607
Brown coal.	5,144	5,503	5,672	5,662	5,729
<i>Total, fuel mining</i>	<i>57,348</i>	<i>61,445</i>	<i>65,863</i>	<i>71,210</i>	<i>81,335</i>
Non-metal (excluding fuel) mining(d)	6,248	6,388	6,821	5,570	6,753
<i>Total, all mining</i>	<i>123,582</i>	<i>138,010</i>	<i>158,380</i>	<i>172,275</i>	<i>191,632</i>
Construction material quarrying(d)	9,364	10,751	11,256	11,136	11,290
<i>Total, all mining and quarrying</i>	<i>132,946</i>	<i>148,761</i>	<i>169,636</i>	<i>183,411</i>	<i>202,922</i>

(a) Excludes mines and quarries employing less than four persons, and drawings by working proprietors; the amounts are net after deducting value of explosives sold to employees. (b) Included in Other metal. (c) Includes Other fuel mining. (d) Incomplete, owing to difficulties of coverage.

Power, fuel, light, and materials, etc. used.

**MINING AND QUARRYING: VALUE OF POWER, FUEL, LIGHT, AND
OTHER MATERIALS AND STORES USED, AUSTRALIA, 1964 TO 1968**
(\$'000)

<i>Industry</i>	<i>1964</i>	<i>1965</i>	<i>1966</i>	<i>1967</i>	<i>1968</i>
Metal mining—					
Gold	8,334	8,433	8,207	8,147	7,397
Silver-lead-zinc	22,688	21,009	22,265	24,923	26,479
Copper-gold	7,698	8,365	10,537	12,544	14,501
Tin	1,854	2,115	3,095	3,676	4,336
Mineral sands	5,496	6,138	7,569	7,820	9,761
Iron	(a)	(a)	3,923	11,564	16,047
Other metal	3,162	4,366	2,285	3,656	4,914
<i>Total, metal mining</i>	<i>49,234</i>	<i>50,427</i>	<i>57,883</i>	<i>72,329</i>	<i>83,434</i>
Fuel mining—					
Black coal(b)	29,114	31,718	35,746	41,069	49,125
Brown coal	1,532	2,108	2,082	1,968	1,987
<i>Total, fuel mining</i>	<i>30,648</i>	<i>33,827</i>	<i>37,828</i>	<i>43,036</i>	<i>51,112</i>
Non-metal (excluding fuel) mining(c)	5,342	5,720	5,641	5,209	6,189
<i>Total, all mining</i>	<i>85,226</i>	<i>89,974</i>	<i>101,351</i>	<i>120,574</i>	<i>140,735</i>
Construction material quarrying(c)	9,728	11,067	12,072	13,115	14,106
<i>Total, all mining and quarrying</i>	<i>94,952</i>	<i>101,041</i>	<i>113,423</i>	<i>133,689</i>	<i>154,841</i>

(a) Included in Other metal. (b) Includes Other fuel mining. (c) Incomplete, owing to difficulties of coverage.

Value of additions and replacements to fixed assets in mining and quarrying

**MINING AND QUARRYING: VALUE OF ADDITIONS AND REPLACEMENTS TO
FIXED ASSETS(a), AUSTRALIA, 1964 TO 1968**
(\$'000)

<i>Industry</i>	<i>1964</i>	<i>1965</i>	<i>1966</i>	<i>1967</i>	<i>1968</i>
Metal mining—					
Gold	1,365	1,094	1,195	1,558	2,516
Silver-lead-zinc	20,071	10,939	12,535	14,595	8,350
Copper-gold	7,419	5,333	6,085	5,813	7,234
Tin	4,459	6,583	9,798	10,361	3,651
Mineral sands	3,592	6,729	11,103	9,674	11,470
Iron	(b)	(b)	36,436	20,112	18,829
Other metal	5,556	32,228	13,051	12,827	14,373
<i>Total, metal mining</i>	<i>42,462</i>	<i>62,906</i>	<i>90,203</i>	<i>74,939</i>	<i>66,423</i>
Fuel mining—					
Black coal(c)	19,952	28,695	45,442	71,506	109,281
Brown coal	5,416	6,115	5,107	5,277	7,668
<i>Total, fuel mining</i>	<i>25,368</i>	<i>34,810</i>	<i>50,548</i>	<i>76,783</i>	<i>116,949</i>
Non-metal (excluding fuel) mining(d)	3,497	2,109	3,638	8,302	9,927
<i>Total, all mining</i>	<i>71,327</i>	<i>99,825</i>	<i>144,387</i>	<i>160,024</i>	<i>193,299</i>
Construction material quarrying(d)	5,867	7,303	5,273	7,640	6,744
<i>Total, all mining and quarrying</i>	<i>77,194</i>	<i>107,128</i>	<i>149,661</i>	<i>167,664</i>	<i>200,043</i>

(a) Excludes mines and quarries employing less than four persons. (b) Included in Other metal. (c) Includes Other fuel mining. (d) Incomplete, owing to difficulties of coverage.

Value of output and production

The following tables show particulars of value of output on an ex-mine basis (local value of production) and value of production (net value of production) for the years 1964 to 1968. *These statistics are on an industry basis and not by product.* Reference to the value of production of mining and quarrying up to 1968 and other industries together with a brief explanation of terms used will be found in Chapter 30 Miscellaneous.

Local value of mining and quarrying production. The following table shows particulars of the local value of production of mining and quarrying for 1964 to 1968.

MINING AND QUARRYING: LOCAL VALUE OF PRODUCTION(a), AUSTRALIA, 1964 TO 1968
(*\$'000*)

<i>Industry</i>	<i>1964</i>	<i>1965</i>	<i>1966</i>	<i>1967</i>	<i>1968</i>
Metal mining—					
Gold	27,406	26,010	26,551	24,688	25,831
Silver-lead-zinc	149,328	156,425	160,079	138,951	173,337
Copper-gold	18,290	19,310	37,320	36,883	39,232
Tin	10,078	12,340	14,566	15,388	17,317
Mineral sands	18,538	25,983	31,216	37,251	38,379
Iron	20,614	25,401	41,755	83,018	131,518
Other metal			17,531	36,625	43,571
<i>Total, metal mining</i>	<i>244,254</i>	<i>265,470</i>	<i>329,018</i>	<i>372,803</i>	<i>469,185</i>
Fuel mining—					
Black coal	128,040	143,704	151,383	160,099	188,786
Brown coal	17,304	18,435	20,064	20,686	21,555
Other fuel	2,164	5,345	9,230	21,286	39,308
<i>Total, fuel mining</i>	<i>147,508</i>	<i>167,484</i>	<i>180,676</i>	<i>202,071</i>	<i>249,649</i>
Non-metal (excluding fuel) mining—					
Clays(b)	7,196	7,222	7,603	7,869	8,835
Gypsum	2,014	2,014	2,005	2,126	2,165
Limestone	9,236	9,711	10,601	12,047	12,382
Salt	2,124	2,556	2,627	2,769	3,600
Other non-metal(b)	7,234	7,808	9,276	7,129	9,946
<i>Total, non-metal mining</i>	<i>27,802</i>	<i>29,311</i>	<i>32,113</i>	<i>31,940</i>	<i>36,928</i>
<i>Total, all mining</i>	<i>419,562</i>	<i>462,266</i>	<i>541,807</i>	<i>606,814</i>	<i>755,762</i>
Construction material quarrying(b)	73,236	80,104	83,344	91,822	96,735
Total, all mining and quarrying	492,800	542,370	625,152	698,636	852,497

(a) Value of output or selling value at the mine or quarry.

(b) Incomplete, owing to difficulties of coverage.

Net value of mining and quarrying production

The following table shows particulars of the net value of production of mining and quarrying for 1964 to 1968.

MINING AND QUARRYING: NET VALUE OF PRODUCTION^(a), AUSTRALIA, 1964 TO 1968 (\$'000)

Industry	1964	1965	1966	1967	1968
Metal mining—					
Gold	19,074	17,577	18,344	16,541	18,434
Silver-lead-zinc	126,640	135,416	137,814	114,028	146,858
Copper-gold	10,592	10,946	26,783	24,340	24,731
Tin	8,632	10,225	11,471	11,711	12,982
Mineral sands	13,042	19,845	23,647	29,431	29,443
Iron	17,040	21,036	37,832	71,454	115,471
Other metal			15,245	32,969	38,658
<i>Total, metal mining</i>	195,018	215,043	271,136	300,474	386,577
Fuel mining—					
Black coal ^(b)	101,088	117,331	124,866	140,317	178,969
Brown coal	15,772	16,327	17,983	18,718	19,568
<i>Total, fuel mining</i>	116,860	133,658	142,849	159,035	198,537
Non-metal (excluding fuel) mining—					
Clays ^(c)	6,288	6,490	6,920	7,046	7,907
Gypsum	1,725	1,743	1,704	1,878	1,889
Limestone	6,792	6,919	7,666	8,879	8,863
Salt	1,847	2,245	2,227	2,235	2,717
Other non-metal ^(c)	5,806	6,194	7,954	6,693	9,358
<i>Total, non-metal mining</i>	22,460	23,591	26,472	26,730	30,735
<i>Total, all mining</i>	334,338	372,292	440,456	486,240	615,848
Construction material quarrying ^(c)	63,508	69,037	71,272	78,708	82,629
Total, all mining and quarrying	397,846	441,330	511,728	564,947	698,477

(a) Local value (i.e. value of output at mine or quarry) less cost of power, fuel, light and other materials and stores used; depreciation and maintenance costs have not been deducted. (b) Includes other fuel mining. (c) Incomplete owing to difficulties of coverage.

Mineral production

This section contains details of the output (quantities and values) of minerals during the year ended June 1969 for all States and Territories and Australia, together with information for Australia for the four preceding years. Figures for 1968-69 are preliminary and subject to revision.

It should be noted that details for the four preceding years relate to a year ended December. The change in 1969 to a June year was made to bring the mineral production collection and the 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

The statistics of mineral production for the year ended June 1969, 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. The table *Value of minerals produced: Mining establishments and other producers* on page 932, in addition to giving details of total production during 1968-69 also gives details of the production attributable to establishments coming within the scope of the mining census and thus to the mining industry as now defined.

It should be noted, however, that, 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 was that the overall value of coal produced in 1968-69 was 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 quantity of minerals produced during 1968-69 and earlier years.

QUANTITY OF MINERALS PRODUCED: STATES AND TERRITORIES, 1968-69

Mineral		N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
METALLIC MINERALS										
Antimony concentrate	tons	261	..	..	..	..	..	..	..	261
Bauxite	'000 tons	11	4	4,127	..	2,075	..	..	..	6,217
Beryllium ore	tons	4	..	..	..	10	..	..	..	14
Bismuth concentrate . . . . .	"	..	..	37	..	..	..	1,491	..	1,528
Chromite . . . . .	"	..	..	..	..	..	..	..	..	..
Copper concentrate(a)	"	44,295	..	354,621	22	3,353	60,523	30,223	..	493,037
Copper ore(b)	"	(c)4,367	865	28,520	(d)	(d)	6,896	1,152	..	46,095
Gold—										
Bullion	oz	395	11,139	52,302	2	668,618	160	89,932	..	822,548
Ore	tons	6	..	..	..	..	..	..	..	6
Iron ore	'000 tons	..	..	..	6,328	23,345	(e)1,446	908	..	32,027
Iron oxide(f)	tons	15,121	559	17,898	..	..	12,562	..	..	46,140
Lead concentrate	"	332,046	..	289,837	..	1,202	13,737	1,895	..	638,717
Lead-copper concentrate . . . . .	"	..	..	..	..	..	12,827	..	..	12,827
Lead ore(g)	"	9,201	..	42,809	400	..	..	..	..	52,410
Lead-zinc middlings	"	3,246	..	..	..	..	..	..	..	3,246
Manganese ore . . . . .	"	..	..	..	45	163,169	..	670,604	..	833,818
Mineral sands—										
Ilmenite concentrate	"	11,607	..	6,553	..	638,533	..	..	..	656,693
Leucoxene concentrate . . . . .	"	..	..	..	..	8,730	..	..	..	8,730
Monazite concentrate	"	726	..	488	..	3,014	..	..	..	4,228
Rutile concentrate	"	206,310	..	102,390	..	1,260	1,702	..	..	311,662
Xenotime concentrate . . . . .	"	..	..	..	..	38	..	..	..	38
Zircon concentrate	"	(h)207,167	..	(h)80,555	..	51,785	2,213	..	..	341,720

For footnotes, see end of table.

QUANTITY OF MINERALS PRODUCED: STATES AND TERRITORIES, 1968-69—continued

Mineral		N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
METALLIC MINERALS—continued										
Molybdenite concentrate	"	..	..	47	..	..	..	..	..	47
Nickel concentrate	"	..	..	..	..	51,140	..	..	..	51,140
Pyrite concentrate	"	..	..	..	79,413	17,153	36,238	..	..	132,804
Tantalite-columbite concentrate	lb	..	..	..	..	202,868	..	..	..	202,868
Tin concentrate ⁽ⁱ⁾	tons	2,463	61	1,632	..	899	8,694	63	..	13,812
Tungsten concentrates—										
Scheelite concentrate	"	..	..	3	..	..	1,560	..	..	1,563
Wolfram concentrate	"	1	..	164	..	..	523	46	..	734
Zinc concentrate	"	546,657	..	150,644	..	..	85,569	3,072	..	785,942
Zinc ore	"	..	..	..	11,200	..	..	..	..	11,200

COAL

	'000 tons	31,887	13	7,395	2,143	1,103	109	..	..	42,650
Black coal—										
Semi-anthracite	"	20	..	..	2	..	..	22
Bituminous	"	31,887	13	7,000	..	..	108	..	..	39,008
Sub-bituminous	"	375	2,143	1,103	..	..	..	3,621
Brown coal (lignite) ^(j)	"	..	23,128	..	..	..	..	..	..	23,128
Brown coal briquettes	"	..	1,471	..	..	..	..	..	..	1,471

CRUDE PETROLEUM (INCLUDING NATURAL GAS)

	'000 bls	..	..	2,415	..	11,649	..	..	..	14,064
Crude oil										
Natural gas	mil. cu ft	..	(k)725	2,005	..	144	..	..	..	2,874
Natural gas condensate	bls	..	..	2,333	..	..	..	..	..	2,333

CONSTRUCTION MATERIALS

	'000 tons	6,772	4,757	1,848	2,553	n.a.	290	483	530	(i)16,711 (j)10,343 286
Sand										
Gravel	"	3,439	2,301	2,094	522	n.a.	1,465			
Dimension stone	"	34	9	(d)	53	179	1			
Crushed and broken stone	"	9,595	12,952	2,988	10,687	4,614	1,437	169	496	42,925
Other (decomposed rock, etc.)	"	21,278	1,600	(d)	..	..	186			23,376

OTHER NON-METALLIC MINERALS

Asbestos	short tons	821	..	..	..	..	..	..	..	821
Barite	"	5,663	..	..	38,832	1,084	..	..	..	45,579
Clays—										
Brick and shale	'000 "	3,355	1,673	375	481	1,031	162	..	..	7,077
Other ^(m)	"	500	216	229	119	162	49	..	..	1,275
Diatomite	"	2,183	..	460	..	..	..	..	..	2,643
Dolomite	"	7,766	..	8,965	286,705	..	2,208	..	..	305,644
Felspar (including cor-nish stone)	"	2,087	..	..	3,076	579	..	..	..	5,742
Garnet concentrate	"	40	..	282	..	..	..	..	..	322
Gypsum	"	28,075	80,355	..	678,276	107,854	..	..	..	894,560
Limestone (including shell and coral)	'000 tons	2,730	(d)	1,320	1,679	(d)	522	..	..	9,078
Lithium ores	"	..	..	..	..	817	..	..	..	817
Lithia (Li ₂ O) content	units ⁽ⁿ⁾	3,443	..	..	..	3,443
Magnesite, crude	tons	23,343	..	..	..	..	..	..	..	23,343
Mineral pigments—red ochre	"	..	..	..	..	588	66	..	..	654
Peat ^(o)	"	549	..	..	..	1,120	144	..	..	1,813
Pebbles—for grinding	"	..	..	..	78	..	1,022	..	..	1,100
Perlite	"	..	..	795	..	..	..	..	..	795
Phosphate rock	"	..	..	..	10,557	..	..	..	..	10,557
Pyrophyllite	"	1,933	..	..	..	..	..	..	..	1,933
Salt	'000 "	..	(d)	119	586	(d)	..	..	..	1,001
Silica	"	316,466	..	198,754	60,815	24,172	18,220	..	..	618,427
Sillimanite	"	1,484	..	..	424	..	..	..	..	1,908
Talc (including steatite and chlorite)	"	2,449	..	..	9,898	29,159	..	..	..	41,506

(a) Includes copper precipitate. (b) Includes cupreous ore for fertiliser. (c) Includes copper slag. (d) Not available for publication. (e) Iron concentrate. (f) For cement manufacture, coal washing, flux and gas purification. (g) Includes silver-lead ore, silver-lead slimes and lead slag. (h) Excludes mixed concentrate shipped interstate for final separation. (i) Includes tin-copper concentrate. (j) Includes brown coal used for briquette production. (k) Source: Department of National Development. (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, 1965 TO 1968-69

Mineral		1965	1966	1967	1968	1968-69(a)
METALLIC MINERALS						
Antimony concentrate	tons	55	150	154	244	261
Bauxite	'000 tons	1,168	1,798	4,176	4,877	6,217
Beryllium ore	tons	38	52	55	15	14
Bismuth concentrate	"	..	1	106	1,553	1,528
Chromite	"	23	..	138	86	..
Copper concentrate(b)	"	389,697	478,710	392,679	452,100	493,037
Copper ore(c)	"	1,193	1,123	2,223	1,430	46,095
Gold—						
Bullion	oz	1,118,503	1,078,587	997,793	908,286	822,548
Ore	tons	..	..	6	6	6
Iron ore	'000 tons	6,695	10,893	17,036	(d)26,204	(d)32,027
Iron oxide(e)	tons	42,053	48,374	53,000	63,093	46,140
Lead concentrate	"	503,356	515,573	537,193	601,709	638,717
Lead-copper concentrate	"	10,424	12,083	12,227	12,558	12,827
Lead ore(f)	"	24,906	19,221	18,224	51,461	52,410
Lead-zinc middlings	"	..	14,254	14,685	5,373	3,246
Manganese ore	"	100,369	312,540	559,967	732,077	833,818
Mineral sands—						
Ilmenite concentrate	"	441,034	513,011	544,216	551,501	656,693
Leucoxene concentrate	"	380	756	696	1,607	8,730
Monazite concentrate	"	2,305	1,984	2,313	2,055	4,228
Rutile concentrate	"	217,330	243,858	265,514	287,617	311,662
Xenotime concentrate . . . . .	"	..	..	18	18	38
Zircon concentrate	"	226,863	235,649	283,682	294,195	341,720
Molybdenite concentrate	"	44,855	8,844	..	22,539	47
Nickel concentrate . . . . .	"	..	..	15,753	36,880	51,140
Osmiridium—native	oz	..	..	..	12	..
Pyrite concentrate	tons	204,011	245,998	252,748	165,265	132,804
Tantalite-columbite concentrate	lb	25,581	10,550	79,587	238,134	202,868
Tin concentrate(g)	tons	6,237	7,604	8,557	10,420	13,812
Tungsten concentrates—						
Scheelite concentrate	"	1,150	1,308	1,202	1,465	1,563
Wolfram concentrate	"	487	498	448	559	734
Zinc concentrate	"	604,211	638,788	702,792	718,311	785,942
Zinc ore	"	..	(h)325	(h)198	2,700	11,200
COAL						
Black coal	'000 tons	31,439	33,334	34,707	40,183	42,650
Semi-anthracite	"	70	45	38	31	22
Bituminous	"	28,228	30,045	31,299	36,665	39,008
Sub-bituminous	"	3,140	3,243	3,370	3,488	3,621
Brown coal (lignite)(f)	"	20,659	21,783	23,384	22,971	23,128
Brown coal briquettes	"	1,908	1,857	1,849	1,553	1,471
CRUDE PETROLEUM (INCLUDING NATURAL GAS)						
Crude oil	'000 bls	2,622	3,390	7,600	13,877	14,064
Natural gas	mil. cu ft	143	143	152	216	2,874
Natural gas condensate	bls	122	121	..	..	2,333

For footnotes see next page.

QUANTITY OF MINERALS PRODUCED: AUSTRALIA, 1965 TO 1968-69—continued

Mineral	1965	1966	1967	1968	1968-69(a)
CONSTRUCTION MATERIALS					
Sand(j) '000 tons	11,444	10,666	11,149	14,406	16,711
Gravel(j) " "	7,760	8,549	9,048	8,340	10,343
Dimension stone " "	467	241	286	275	286
Crushed and broken stone " "	39,733	46,796	46,268	44,375	42,925
Other " "	21,363	22,216	25,202	26,581	23,376
OTHER NON-METALLIC MINERALS					
Asbestos short tons	11,566	13,468	600	897	821
Barite tons	11,976	13,724	15,666	39,155	45,579
Clays—					
Brick and shale '000 tons	5,056	5,187	5,697	6,422	7,077
Other(j) " "	1,007	952	961	1,396	1,275
Diatomite tons	7,063	7,592	11,103	6,725	2,643
Dolomite " "	258,661	256,008	290,659	316,731	305,644
Felspar (including cornish stone) " "	8,726	7,259	4,450	4,838	5,742
Garnet concentrate " "	130	239	591	167	322
Gypsum " "	833,521	801,552	914,084	843,744	894,560
Limestone (including shell and coral) '000 tons	7,516	7,730	8,355	8,470	9,078
Lithium ores tons	310	933	667	738	817
Lithia (LiO ₂) content units(k)	1,302	3,919	2,906	3,112	3,443
Loam—for foundry moulding tons	15,580	9,506	n.a.	n.a.	n.a.
Magnesite, crude " "	26,362	19,556	23,653	23,146	23,343
Mineral pigments—red ochre " "	227	272	358	526	654
Peat(l) . . . . . " "	..	..	..	..	1,813
Pebbles—for grinding " "	1,049	1,043	1,305	1,321	1,100
Perlite " "	764	1,544	1,389	1,049	795
Phosphate rock " "	4,519	5,715	11,770	5,744	10,557
Pyrophyllite . . . . . " "	..	..	..	501	1,933
Salt '000 tons	655	645	703	900	1,001
Serpentine tons	151	..	..	..	..
Silica " "	320,937	347,123	443,555	542,680	618,427
Sillimanite " "	2,554	2,664	1,183	2,115	1,908
Talc (including steatite and chlorite) " "	19,719	17,327	17,779	38,280	41,506

(a) Year ended 30 June. (b) Includes copper precipitate. (c) Includes cupreous ore for fertiliser. (d) Includes iron concentrate. (e) For cement manufacture, coal washing, flux and gas purification. (f) Includes silver-lead ore, silver-lead slimes and lead slag. (g) Includes tin-copper concentrate. (h) Zinc ore for fertiliser. (i) Includes brown coal used for briquette production. (j) Incomplete, owing to difficulties of coverage. (k) 1 unit = 22.4 lb. (l) 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

The following tables show the contents of metallic minerals produced in 1968-69 and earlier years.

**CONTENTS OF METALLIC MINERALS PRODUCED
STATES AND NORTHERN TERRITORY, 1968-69**

<i>Content of metallic minerals produced</i>	<i>N.S.W.</i>	<i>Vic.</i>	<i>Qld</i>	<i>S.A.</i>	<i>W.A.</i>	<i>Tas.</i>	<i>N.T.</i>	<i>Aust.</i>
Alumina (Al ₂ O ₃)	'000 tons	4	2	2,414	..	787	..	3,207
Antimony	tons	854	..	..	..	..	..	854
Beryllium oxide (BeO)	units(a)	1	..	..	..	122	..	123
Bismuth	lb	..	..	20,720	..	..	400,960	421,680
Cadmium	tons	1,117	..	..	..	77	16	1,210
Cobalt . . . . .	..	113	..	..	..	99	..	212
Copper . . . . .	..	13,881	30	79,700	89	1,665	18,632	122,015
Gold	fine oz	9,784	8,613	77,031	68	479,124	39,544	115,401
Iron(b)	'000 tons	..	..	..	4,053	14,872	(c)1,008	568
Lead	tons	257,379	..	116,816	79	876	15,218	1,166
Manganese(d) . . . . .	..	5,499	..	..	..	75,613	257	291,156
Manganese dioxide (MnO ₂)(e) . . . . .	..	..	..	..	30	..	..	118
Molybdenum disulphide (MoS ₂)	lb	124	..	89,500	..	..	..	89,624
Monazite	tons	652	..	419	..	2,713	..	3,784
Nickel . . . . .	..	..	..	..	..	6,086	..	6,086
Silver	'000 fine oz	9,786	..	10,422	2	166	1,789	325
Sulphur(f)	tons	220,171	..	..	34,259	7,508	50,575	1,323
Tantalite-columbite (Ta ₂ O ₅ + Nb ₂ O ₅)	lb	..	..	..	..	17,645	..	17,645
Tin	tons	1,485	41	1,129	..	638	4,084	34
Titanium dioxide (TiO ₂) . . . . .	..	203,281	..	102,669	..	358,502	1,598	666,050
Tungstic oxide (WO ₃)	units(a)	49	..	12,162	..	148,800	2,100	163,111
Yttrium oxide (Y ₂ O ₃)	lb	..	..	..	..	16,312	..	16,312
Zinc	tons	303,453	..	78,285	3,360	..	50,617	437,385
Zirconium dioxide (ZrO ₂) . . . . .	..	137,884	..	50,853	..	40,338	2,159	231,234

(a) 1 unit = 22.4 lb. (b) Excludes iron content of iron oxide not intended for metal extraction. (c) Contained in iron concentrate. (d) Content of metallurgical grade manganese ore and zinc concentrate. (e) Content of manganese ore of other than metallurgical grade. (f) Sulphur content of pyrite and other minerals from which sulphur is recovered.

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

CONTENTS OF METALLIC MINERALS PRODUCED: AUSTRALIA, 1965 TO 1968-69

<i>Content of metallic minerals produced</i>	<i>1965</i>	<i>1966</i>	<i>1967</i>	<i>1968</i>	<i>1968-69</i>	
Alumina (Al ₂ O ₃)	'000 tons	613	939	2,258	2,633	3,207
Antimony	tons	944	971	930	842	854
Beryllium oxide (BeO)	units(a)	457	637	675	178	123
Bismuth	lb	..	717	25,536	403,200	421,680
Cadmium	tons	1,155	1,212	1,324	1,359	1,210
Chromic oxide (Cr ₂ O ₃) . . . . .	..	10	..	44	27	..
Cobalt . . . . .	..	90	84	146	235	212
Copper . . . . .	..	90,388	109,537	90,361	107,906	122,015
Gold	fine oz	877,643	916,985	805,336	781,782	729,565
Iron(b)	'000 tons	4,297	6,956	10,928	(c)16,920	(c)20,502
Lead	tons	362,137	364,898	375,779	382,671	391,534
Manganese(d) . . . . .	..	55,280	151,401	264,660	345,099	372,525
Manganese dioxide (MnO ₂)(e) . . . . .	..	1,652	4,091	228	134	148
Molybdenum disulphide (MoS ₂)	lb	41,911	5,549	..	19,164	89,624
Monazite	tons	2,165	1,836	2,163	1,849	3,784
Nickel . . . . .	..	..	..	2,061	4,603	6,086
Osmiridium	oz	..	..	..	12	..
Platinum . . . . .	..	..	13	..	..	..
Silver	'000 fine oz	17,281	18,888	19,842	21,394	22,490
Sulphur(f)	tons	345,554	371,567	392,371	349,990	313,836
Tantalite-columbite (Ta ₂ O ₅ + Nb ₂ O ₅)	lb	10,281	5,698	32,906	56,179	17,645
Tin	tons	3,849	4,807	5,586	6,537	7,411
Titanium dioxide (TiO ₂) . . . . .	..	448,318	516,745	552,894	578,720	666,050
Tungstic oxide (WO ₃)	units(a)	117,672	130,776	119,210	144,552	163,111
Yttrium oxide (Y ₂ O ₃)	lb	..	..	9,475	9,500	16,312
Zinc	tons	349,231	369,341	400,527	415,722	437,385
Zirconium dioxide (ZrO ₂) . . . . .	..	151,035	156,581	188,462	195,585	231,234

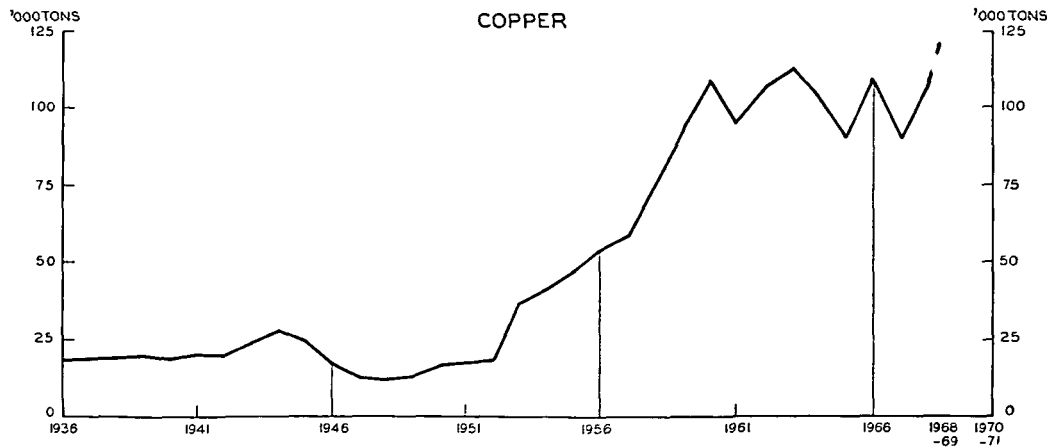
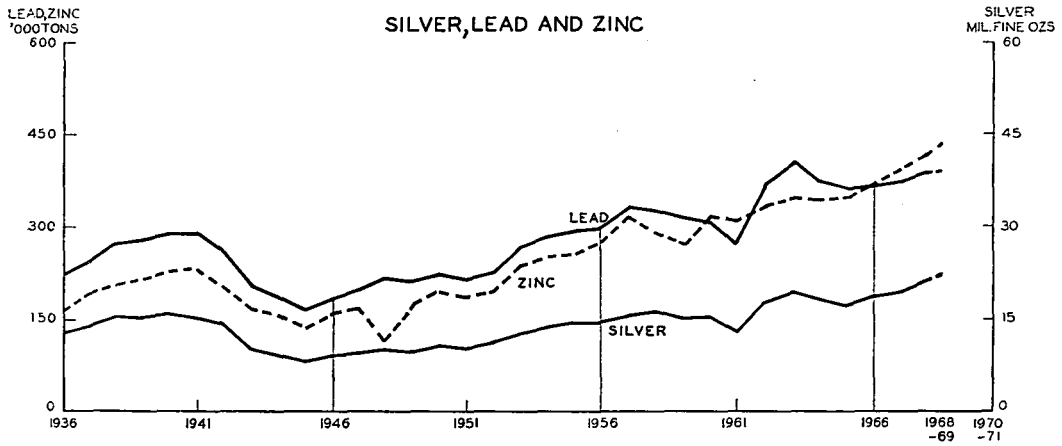
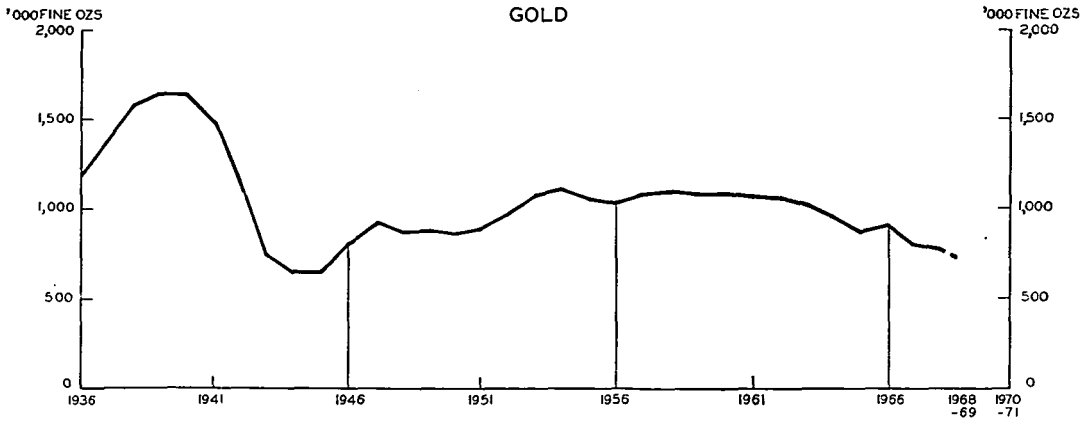
(a) 1 unit = 22.4 lb. (b) Iron oxide for metal extraction. (c) Includes iron contained in iron concentrate. (d) Content of metallurgical grade manganese ore and zinc concentrate. (e) Content of manganese ore of other than metallurgical grade. (f) Sulphur content of pyrite and other minerals from which sulphur is recovered.

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

MINE PRODUCTION OF PRINCIPAL METALS: AUSTRALIA

(METALLIC CONTENT OF MINERALS)

1936 TO 1968-69

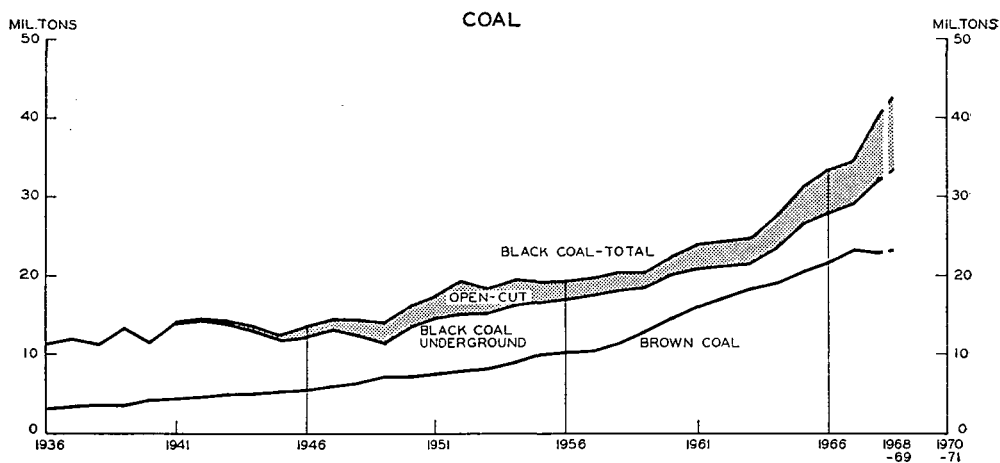
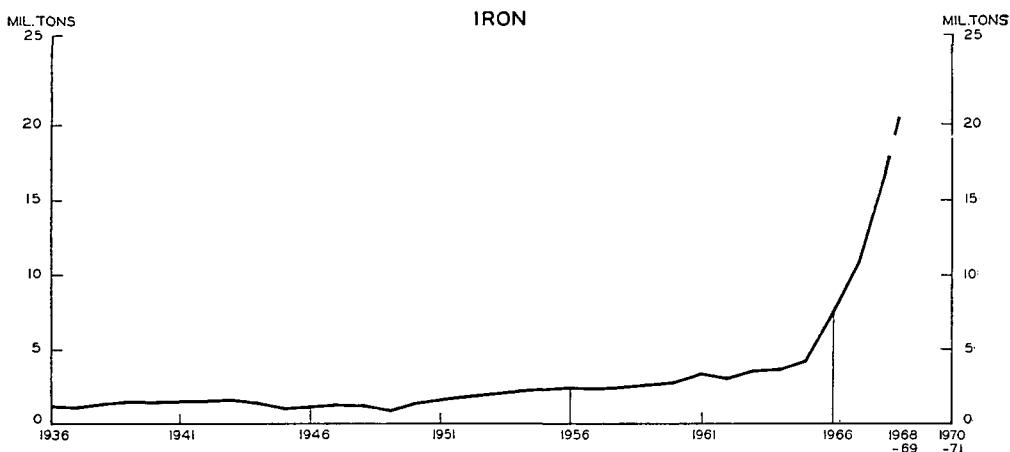
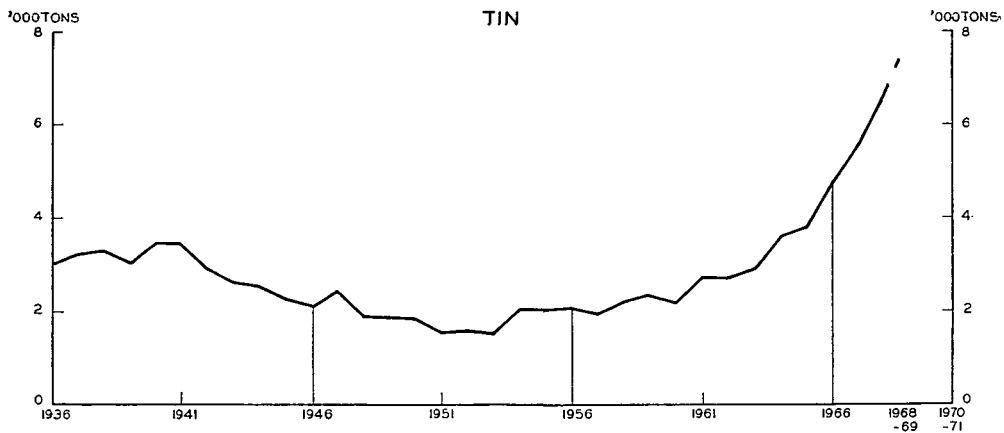


NOTE. PRIOR TO 1968-69 MINERAL PRODUCTION FIGURES WERE COLLECTED ON A CALENDAR YEAR BASIS

PLATE 47

MINE PRODUCTION OF PRINCIPAL METALS AND PRODUCTION OF COAL

(METALLIC CONTENT OF MINERALS)
1936 TO 1968-69



NOTE. PRIOR TO 1968-69 MINERAL PRODUCTION FIGURES WERE COLLECTED ON A CALENDAR YEAR BASIS

PLATE 48

Graphs showing details of the mine production of principal metals (metallic content) and coal from 1936 to 1968-69 are included on plates 47 and 48, pages 929 and 930.

Value of minerals produced, 1965 to 1968-69

Particulars of the values of minerals (mine and quarry products) produced are shown in the following table. The values represent the selling value at the mine or quarry of minerals produced during the years concerned.

VALUE OF MINERALS PRODUCED: AUSTRALIA, 1965 TO 1968-69 (\$'000)

	1965	1966	1967	1968	1968-69(a)
Metallic minerals—					
Bauxite	4,600	(b)	(b)	(b)	(b)
Copper ore, concentrate, etc.	50,790	87,523	72,515	92,396	106,469
Gold ore, concentrate, other forms, etc.	25,619	26,371	24,456	23,525	22,953
Ilmenite concentrate	3,755	4,242	4,390	4,752	5,380
Iron ore	14,640	41,728	82,994	131,482	193,435
Lead and lead-silver ore and concentrate, lead-copper concentrate, etc.	87,947	76,831	73,654	89,705	85,699
Manganese ore	808	3,462	8,007	8,358	10,734
Nickel concentrate . . . . .	..	..	(b)	(b)	(b)
Pyrite concentrate	3,040	(b)	(b)	1,842	1,713
Rutile concentrate	15,038	17,088	19,615	21,528	23,413
Tin concentrates	12,237	14,332	15,011	16,691	19,200
Tungsten concentrates	2,692	4,469	4,509	5,514	6,723
Zinc ore and concentrate	36,818	32,890	29,354	30,398	35,397
Zircon concentrate	6,136	8,255	10,937	10,967	11,515
Other metallic minerals	548	610	1,251	3,354	4,488
<i>Total, metallic minerals</i>	<i>264,668</i>	<i>327,633</i>	<i>370,892</i>	<i>468,353</i>	<i>563,077</i>
Coal—					
Black coal	143,703	151,380	160,099	188,785	198,713
Brown coal	18,436	20,064	20,686	21,555	20,880
<i>Total, coal</i>	<i>162,139</i>	<i>171,444</i>	<i>180,785</i>	<i>210,340</i>	<i>219,593</i>
Crude petroleum (including natural gas)—					
Crude oil	5,266	9,148	21,200	39,191	39,589
Natural gas (including condensate)	78	81	86	116	925
<i>Total, crude petroleum</i>	<i>5,344</i>	<i>9,229</i>	<i>21,286</i>	<i>39,307</i>	<i>40,513</i>
Construction materials(c)	80,183	83,449	91,789	96,812	115,062
Other non-metallic minerals(c)	29,244	31,921	31,946	36,928	41,987
Total, all minerals and construction materials	541,578	623,678	696,701	851,742	980,231
New South Wales	266,856	262,358	274,123	298,392	314,802
Victoria	48,927	53,075	57,339	59,026	58,648
Queensland	98,965	138,483	135,379	185,753	209,432
South Australia	39,465	41,954	40,449	42,064	72,325
Western Australia	49,070	78,918	134,319	195,498	234,854
Tasmania	28,998	34,561	34,688	44,968	59,250
Northern Territory	8,309	13,283	19,316	24,846	29,370
Australian Capital Territory	986	1,046	1,087	1,195	1,550

(a) Year ended 30 June. (b) Not available for publication. (c) Incomplete owing to difficulties of coverage.

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

VALUE OF MINERALS PRODUCED: MINING ESTABLISHMENTS AND OTHER PRODUCERS(a)
AUSTRALIA, 1968-69
 (\$'000)

	<i>Value of mining products</i>		
	<i>Mining establishments</i>	<i>Other producers</i>	<i>Total</i>
Mineral group—			
Metallic minerals	561,379	1,698	563,077
Coal	219,199	394	219,593
Crude petroleum (including natural gas)	40,513	..	40,513
Construction materials	94,083	(b)20,978	115,062
Other non-metallic minerals	31,403	(c)10,584	41,987
Total	946,577	33,654	980,231
By State/Territory			
New South Wales	300,863	13,940	314,802
Victoria	53,838	4,810	58,648
Queensland	206,330	3,102	209,432
South Australia	65,444	6,881	72,325
Western Australia	233,207	1,645	234,854
Tasmania	56,977	2,273	59,250
Northern Territory	28,438	932	29,370
Australian Capital Territory	1,480	70	1,550

(a) See page 924. (b) Principally producers classified to the construction and transport industries, local government authorities and other small producers. (c) Principally brick and cement manufacturing establishments producing clay and limestone.

Overseas participation in Australian mining industry

Introduction

Any attempt to provide statistical information on the extent of overseas participation in local industry involves difficult problems of statistical concept and measurement. Broadly, there are two ways in which overseas participation may be measured. One is to examine the financial accounts of Australian companies and compare the value of *assets* of companies in which there is significant overseas investment with those of other Australian companies. The other is to examine the *operations* (as expressed in terms of production, wages and salaries, output, etc.) of establishments of Australian companies in which there is significant overseas investment and compare their operations with those of establishments of other Australian companies. The second method has been adopted for a series of studies in overseas participation in the Australian mining industry.

Scope of the statistics

The statistics relate to the operations of establishments employing four or more persons in the mining and quarrying industry as defined for the annual mining and quarrying census except for establishments engaged in construction material quarrying and clay mining, which are excluded.

Classification of companies

The extent of overseas participation in the mining industry is measured by the operations of the establishments of companies in which there is direct investment from overseas, as determined by the annual survey of overseas investments. These are defined as follows.

- (i) Companies in Australia in which at least 50 per cent of the ordinary shares (or voting stock) is held by individual shareholders or companies resident in one overseas country, or where 25 per cent or more of the ordinary shares (or voting stock) is held by one company, or a group of companies, incorporated in one overseas country.
- (ii) Branches of companies incorporated overseas and registered in Australia as foreign companies.
- (iii) Wholly and partly owned subsidiaries and sub-subsidiaries, etc., of companies included in (i) and (ii) above.

Investment in ordinary shares or voting stock of Australian companies, including companies in which there is direct investment from overseas, where the proportion of shares held in a single country falls below the percentages specified in (i) above is defined as portfolio investment. Because of the difficulties encountered in determining the proportion of ordinary shares or voting stock of individual Australian companies held by portfolio investors overseas, *the figures for overseas participation in the mining industry exclude participation by way of portfolio investment.*

Further information available

In the following tables the degree of overseas participation is expressed in terms of net value of production only. Further details in terms of the value of power, fuel and materials used, local value of production, value of additions and replacements to fixed assets, salaries and wages paid, and average number of persons employed, as well as the value of production, may be found in the mimeographed bulletin *Overseas Participation in Australian Mining Industry*, 1968. The terms 'net . . .' and 'local value of production' are defined in Chapter 30, Miscellaneous.

OVERSEAS OWNERSHIP AND CONTROL

In analysing the extent of overseas participation in local industry it is usual to distinguish between two aspects, overseas ownership and overseas control.

Overseas ownership

Statistics which give a general indication of the degree of overseas ownership in terms of the net value of production of Australian mining establishments are presented in the two following tables. In the compilation of these statistics the data for an establishment of a company in which there is no direct investment from overseas are allocated wholly to Australian ownership. The data relating to an establishment of a company in which there is direct investment from overseas are apportioned to overseas and Australian ownership according to the proportion of the ordinary shares (or voting stock) of the company that is held by the direct overseas investors.

However, an exception has been made to the strict application of the definition of direct overseas investment in the measurement of overseas ownership of the Australian mining industry. This exception is designed to take account of a small number of important cases of portfolio investment where overseas companies participated in a consortium of companies which made the initial decision to develop a major mining project. The participation of these companies in the initial decision for the development of the mining project implies a kind of participation different from that normally associated with portfolio investment and more akin to direct investment. Special arrangements have been made therefore, to include in the measurement of overseas ownership, investment by overseas companies whose participation is represented by 10 per cent or more of the ordinary shares of such projects. This participation is not taken into account in statistics of overseas control. This change has had a minor effect on statistics of overseas ownership of the Australian mining industry for 1966 and earlier years.

MINING(a): NET VALUE OF PRODUCTION APPORTIONED TO AUSTRALIAN AND DIRECT OVERSEAS OWNERSHIP, BY INDUSTRY, 1966 TO 1968

Industry and ownership	Value (\$'000)			Proportion Australian and overseas (per cent)		
	1966	1967	1968	1966	1967	1968
Metal mining—						
Australian(b)	144,588	149,095	187,939	53.7	50.0	49.0
Overseas	124,622	149,013	195,907	46.3	50.0	51.0
Fuel mining—						
Australian(b)	109,844	118,253	134,156	76.9	74.4	67.7
Overseas	32,918	40,593	63,966	23.1	25.6	32.3
Non-metal (excluding fuel) mining—						
Australian(b)	10,830	10,870	11,767	81.1	80.4	80.0
Overseas	2,521	2,658	2,938	18.9	19.6	20.0
Total mining—						
Australian(b)	265,262	278,218	333,863	62.4	59.1	56.0
Overseas	160,061	192,264	262,811	37.6	40.9	44.0
Grand total	425,323	470,483	596,674	100.0	100.0	100.0

(a) Excludes construction material quarrying and clay mining.

(b) Includes ownership by overseas portfolio investors.

MINING(a): NET VALUE OF PRODUCTION APPORTIONED TO DIRECT OVERSEAS OWNERSHIP(b), BY COUNTRY AND BY PROPORTION OF DIRECT OVERSEAS EQUITY, 1966 TO 1968

Country, and proportion of direct overseas equity	Value (\$'000)			Proportion(c) (per cent)		
	1966	1967	1968	1966	1967	1968
Country—						
United Kingdom	79,891	90,095	102,957	18.7	19.2	17.2
United States of America	64,613	87,256	142,806	15.2	18.5	23.9
Other	15,557	14,913	17,048	3.7	3.2	2.9
Proportion of direct overseas equity—						
25 per cent but less than 50 per cent	3,094	7,527	8,303	0.7	1.6	1.4
50 per cent but less than 75 per cent	47,901	37,642	56,836	11.3	8.0	9.5
75 per cent and over	109,066	147,095	197,672	25.6	31.3	33.1
Total apportioned to direct overseas ownership	160,061	192,264	262,811	37.6	40.9	44.0

(a) Excludes construction material quarrying and clay mining. (b) Excludes ownership by overseas portfolio investors.
(c) Of total net value of mining production.

Overseas control

The statistics in the following tables provide an indication of the relative importance of mining establishments of companies in which there is direct overseas investment. The concept of direct overseas investment is directly related to the concept of overseas control, and the statistics in these tables provide a measure of the net value of production of mining establishments of companies which can be regarded as subject to a degree of overseas control. The statistics have been derived by allocating data relating to each mining establishment wholly to either one or the other of the following categories: (i) establishments of direct overseas investment companies; (ii) other establishments.

The classification of establishments of companies in which 50 per cent of the voting stock is held in one overseas country (or 25 per cent by one overseas company) as subject to a degree of overseas control is, of course, based on a statistical convention. Such a convention is needed because of the lack of specific information as to the arrangements for managerial control of individual companies. The convention adopted for this study (including the actual percentages used) is the one suggested by the International Monetary Fund for use in the absence of other information. There are avenues of control other than through direct equity interest, e.g. through franchise or patent rights, marketing arrangements, financial commitments, etc. Such arrangements, of course, also typically exist between companies in which there is direct investment and their overseas parent companies and associated companies. Further, ownership of less than 25 per cent of voting stock may, in some cases, be sufficient to achieve effective control of a company's activities, just as in other cases ownership of more than 25 per cent of voting stock may not constitute control. In addition, the relationship between overseas parent companies and their Australian branches and subsidiaries covered by the statistics in the following tables can be one of *potential* rather than *actual* control.

A special problem does exist, however, in the strict application of the definition of direct overseas investment described above to the measurement of overseas control. This occurs where a single overseas company has an equity interest in an Australian company which is 25 per cent or more but less than 50 per cent. In such cases, a single Australian company may have an equity interest which is greater than the equity interest of the direct overseas investment company. To overcome this problem, an examination has been made of all companies engaged in mining in which the direct overseas equity is 25 per cent or more but less than 50 per cent. Where an Australian company holds a greater proportion of the equity than the direct overseas investment company the company is not regarded as subject to a degree of overseas control and is classified to 'other establishments'. However, this departure from the strict application of the definition of direct overseas investment to the measurement of overseas control does not affect the statistics for 1966 and earlier years.

**MINING(a): NET VALUE OF PRODUCTION ATTRIBUTED TO DIRECT OVERSEAS
AND AUSTRALIAN CONTROL, BY INDUSTRY, 1966 TO 1968**

Industry and category of control	Value (\$'000)			Proportion (per cent)		
	1966	1967	1968	1966	1967	1968
Metal mining—						
Overseas	167,191	193,531	264,008	62.1	64.9	68.8
Australian	102,019	104,577	119,839	37.9	35.1	31.2
Fuel mining—						
Overseas	40,927	51,703	78,735	28.7	32.5	39.7
Australian	101,835	107,143	119,387	71.3	67.5	60.3
Non-metal (excluding fuel) mining—						
Overseas	3,669	3,862	4,205	27.5	28.5	28.6
Australian	9,681	9,667	10,501	72.5	71.5	71.4
Total mining—						
Overseas	211,788	249,096	346,947	49.8	52.9	58.1
Australian	213,535	221,387	249,727	50.2	47.1	41.9
Grand total	425,323	470,483	596,674	100.0	100.0	100.0

(a) Excludes construction material quarrying and clay mining.

**MINING(a): NET VALUE OF PRODUCTION ATTRIBUTED TO DIRECT OVERSEAS
CONTROL, BY PROPORTION OF DIRECT OVERSEAS EQUITY, 1966 TO 1968**

Proportion of direct overseas equity	Value (\$'000)			Proportion(b) (per cent)		
	1966	1967	1968	1966	1967	1968
25 per cent but less than 50 per cent	7,948	17,492	19,217	1.9	3.7	3.2
50 per cent but less than 75 per cent	91,913	72,851	109,685	21.6	15.5	18.4
75 per cent and over	111,927	158,753	218,045	26.3	33.7	36.5
Total attributed to overseas control	211,788	249,096	346,947	49.8	52.9	58.1

(a) Excludes construction material quarrying and clay mining. (b) Of total net value of mining production.

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 been changed to a year 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 practically the same as those in the annual mining census (see section, *Mineral industry statistics*, page 912 for further details) 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.

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 1966 to 1969-70.

**MINERAL EXPLORATION (OTHER THAN FOR PETROLEUM)
STATES AND NORTHERN TERRITORY, 1966 TO 1969-70**

	EXPENDITURE(a) (\$'000)				
	1966(b)	1967(b)	1968	1968-69(c)	1969-70(c)
PRIVATE EXPLORATION					
New South Wales	4,872	4,594	5,620	7,272	16,562
Victoria	1,231	1,452	1,476	1,600	2,353
Queensland	8,340	11,657	13,343	18,018	25,078
South Australia	1,358	1,203	2,661	2,961	5,760
Western Australia	6,534	10,203	23,148	35,412	59,821
Tasmania	2,870	2,180	2,059	2,408	3,278
Northern Territory	2,909	3,532	4,156	4,891	5,241
<i>Total</i>	<i>28,115</i>	<i>34,822</i>	<i>52,463</i>	<i>72,562</i>	<i>118,094</i>
GOVERNMENT EXPLORATION					
Commonwealth(d)	1,923	2,803	3,529	3,591	3,995
State Mines Departments	1,649	1,768	2,329	2,939	2,708
<i>Total</i>	<i>3,572</i>	<i>4,571</i>	<i>5,858</i>	<i>6,530</i>	<i>6,704</i>
TOTAL EXPENDITURE					
On drilling	13,994	15,490	20,448	26,196	33,522
Other	17,693	23,903	37,873	52,896	91,276
Australia	31,687	39,393	58,321	79,092	124,798
Payments to contractors(e)	8,380	12,181	18,506	27,721	40,963

For footnotes see next page.

MINERAL EXPLORATION (OTHER THAN FOR PETROLEUM)
STATES AND NORTHERN TERRITORY, 1966 TO 1969-70—*continued*

		EMPLOYMENT(<i>f</i>) (<i>'000</i> man-weeks worked)				
		1966(<i>b</i>)	1967(<i>b</i>)	1968	1968-69(<i>c</i>)	1969-70(<i>c</i>)
PRIVATE EXPLORATION						
New South Wales		19.2	22.5	20.9	26.1	30.7
Victoria		8.3	5.6	7.0	6.3	5.7
Queensland		35.6	27.2	33.3	36.5	48.4
South Australia		3.2	3.6	7.2	9.2	10.9
Western Australia		23.2	37.6	52.8	67.5	103.3
Tasmania		9.9	7.4	7.5	7.4	8.8
Northern Territory		8.8	8.8	11.0	10.8	12.7
<i>Total</i>		108.2	112.6	139.6	163.9	220.5
GOVERNMENT EXPLORATION						
Commonwealth(<i>d</i>)		11.1	14.2	11.9	11.7	16.5
State Mines Departments		15.0	15.9	13.7	17.0	20.9
<i>Total</i>		26.1	30.1	25.5	28.7	37.4
TOTAL						
By professional persons(<i>g</i>)		44.0	46.7	49.9	57.6	73.1
By non-professional persons(<i>h</i>)		90.3	96.0	115.2	135.0	184.8
<i>Australia</i>		134.3	142.7	165.1	192.6	257.9
FOOTAGE DRILLED, SUNK OR DRIVEN (<i>'000</i> ft)						
PRIVATE EXPLORATION						
New South Wales		946	908	1,031	1,146	1,528
Victoria		179	182	128	141	137
Queensland		1,515	2,029	1,669	1,873	1,959
South Australia		183	161	227	250	614
Western Australia		640	907	1,768	2,493	6,344
Tasmania		169	152	149	177	192
Northern Territory		248	259	303	352	292
<i>Total</i>		3,880	4,598	5,273	6,432	11,066
GOVERNMENT EXPLORATION						
Commonwealth(<i>d</i>)		6	6	15	21	28
State Mines Departments		194	290	282	314	283
<i>Total</i>		200	296	297	335	311
TOTAL FOOTAGE DRILLED, SUNK OR DRIVEN(<i>i</i>)						
Drilled—core		1,645	1,727	2,003	2,641	3,045
non-core		2,375	3,138	3,445	3,916	8,101
Sunk or driven		59	30	122	210	231
<i>Australia</i>		4,080	4,896	5,570	6,767	11,376

(*a*) Expenditure whether charged as working expenses or capitalised. (*b*) Excludes 'Other private exploration', not collected prior to 1968; *see text*. (*c*) Year ended 30 June. (*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*) Geologists, geophysicists, engineers, etc., engaged on exploration work. (*h*) Drill operators, field hands, etc. (*i*) '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 Expenditures 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 petroleum and/or gas by geological, geophysical, geochemical, and other means, 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 or natural gas. The cost of drilling developmental oil and/or gas wells and expenditure on production facilities and pipelines, and production costs, etc., 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, 1965 TO 1969 (\$'000)

	1965	1966	1967	1968	1969
PRIVATE SOURCES(a)					
Utilised in—					
New South Wales	3,640	1,706	1,284	1,126	2,473
Victoria	3,796	7,007	17,557	20,403	19,567
Queensland	14,883	13,670	5,116	5,392	7,157
South Australia	4,559	4,059	6,257	3,261	4,311
Western Australia	14,245	15,267	12,047	22,118	26,806
Tasmania	829	1,293	2,424	998	1,837
Northern Territory	6,246	6,367	6,978	6,222	7,075
<i>Australia</i>	<i>48,197</i>	<i>49,369</i>	<i>51,662</i>	<i>59,519</i>	<i>69,226</i>
GOVERNMENT SOURCES					
Payments under <i>Petroleum Search Subsidy Act</i> 1959–1969—					
Utilised in—					
New South Wales	633	724	516	474	548
Victoria	609	640	727	1,940	441
Queensland	3,818	2,194	1,767	1,419	1,524
South Australia	949	769	1,058	1,407	609
Western Australia	2,487	3,355	3,441	4,027	6,286
Tasmania	107	570	469	497	903
Northern Territory	1,157	1,365	1,657	1,448	2,561
<i>Total subsidy payments, Australia</i>	<i>9,759</i>	<i>9,617</i>	<i>9,635</i>	<i>11,212</i>	<i>12,871</i>
Utilised for—					
Geophysical	5,311	4,910	4,512	3,590	3,557
Drilling	4,448	4,707	5,123	7,622	9,315
Other Government sources—					
Commonwealth(a)	3,824	3,649	4,508	4,756	4,238
State Mines Departments	711	767	466	783	832
<i>Total other sources, Australia</i>	<i>4,535</i>	<i>4,416</i>	<i>4,974</i>	<i>5,539</i>	<i>5,070</i>
<i>Total Government sources, Australia</i>	<i>14,294</i>	<i>14,033</i>	<i>14,609</i>	<i>16,751</i>	<i>17,941</i>
TOTAL FUNDS, PRIVATE AND GOVERNMENT					
<i>Australia</i>	<i>62,491</i>	<i>63,402</i>	<i>66,271</i>	<i>76,270</i>	<i>87,166</i>

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

**WELLS AND FOOTAGE DRILLED IN PETROLEUM EXPLORATION
STATES AND TERRITORIES, 1969(a)**

		<i>N.S.W.</i>	<i>Vic.</i>	<i>Qld</i>	<i>S.A.</i>	<i>W.A.</i>	<i>Tas.</i>	<i>N.T.</i>	<i>Total</i>
Wells drilled(b)	No.	8	32	49	14	206	3	6	318
Average total depth of wells drilled	ft	3,794	6,685	5,752	4,597	7,500	3,257	9,429	6,150
Wells completed as potential oil producers	No.	..	10	..	..	97	..	..	107
Wells completed as potential gas producers	"	..	1	13	1	7	..	..	22
Wells drilled or drilling over 10,000 feet	"	..	9	3	..	9	..	3	24
Footage drilled—									
Completed wells	ft	30,353	234,651	244,272	64,355	636,818	9,770	36,583	1,256,802
Uncompleted holes(c)	"	3,984	29,300	30,723	..	10,871	..	4,044	78,922
Total footage drilled	ft	34,337	263,951	274,995	64,355	647,689	9,770	40,627	1,335,724

(a) With the exception of 'average total depth of wells drilled', these data include particulars for developmental wells. (b) Number of holes which reached total depth during the year. (c) Wells suspended or drilling at 31 December.

**WELLS AND FOOTAGE DRILLED IN PETROLEUM EXPLORATION
AUSTRALIA, 1965 TO 1969(a)**

		<i>1965</i>	<i>1966</i>	<i>1967</i>	<i>1968</i>	<i>1969</i>
Wells drilled(b)	No.	208	134	274	225	318
Average total depth of wells drilled	ft	5,401	6,155	5,573	6,135	6,150
Wells completed as potential oil producers	No.	25	12	174	64	107
Wells completed as potential gas producers	"	20	14	13	22	22
Wells drilled or drilling over 10,000 feet	"	16	19	11	15	24
Footage drilled—						
Completed wells	ft	1,057,325	687,041	986,079	959,067	1,256,802
Uncompleted holes(c)	"	83,849	68,781	53,862	59,889	78,922
Total footage drilled	ft	1,141,174	755,822	1,039,941	1,018,956	1,335,724

(a) With the exception of 'average total depth of wells drilled' for 1967, 1968 and 1969, these data include particulars for developmental wells. (b) Number of holes which reached total depth during the year. (c) Wells suspended or drilling at 31 December of the year shown.

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 22, Manufacturing Industry.

Principal products

The following table shows particulars of the production of certain important manufactured products of mineral origin during the years 1964-65 to 1968-69.

**PRODUCTION OF PRINCIPAL MANUFACTURED PRODUCTS
OF MINERAL ORIGIN: AUSTRALIA, 1964-65 TO 1968-69**

<i>Commodity</i>		1964-65	1965-66	1966-67	1967-68	1968-69
METALS(a)						
Non-ferrous—						
Alumina	tons	175,398	227,077	474,716	1,136,208	1,591,802
Refined aluminium	"	85,497	87,222	92,826	87,733	109,998
Blister copper(b)	"	57,880	98,529	77,788	75,344	109,582
Refined copper	"	53,441	91,588	74,313	72,166	94,732
Lead bullion (for export)(b)	"	63,827	81,709	84,690	101,477	132,218
Refined lead	"	199,032	188,197	192,384	186,908	175,289
Refined zinc	"	189,395	196,534	197,030	187,325	228,224
Refined tin	"	2,931	3,524	3,224	3,955	3,960
Ferrous—						
Pig iron	'000 tons	3,936	4,380	4,893	5,209	5,722
Steel ingots	"	5,131	5,561	6,057	6,298	6,599
Precious—						
Refined gold(c)	'000 f oz	871	774	726	655	622
Refined silver	"	8,939	8,766	9,825	9,693	9,134
FUELS						
Coal products—						
Metallurgical coke	'000 tons	3,118	3,179	3,365	3,678	4,106
Brown coal briquettes	"	1,893	1,883	1,820	1,745	1,471
Petroleum products—						
Motor spirit	mil. gal	1,482	1,524	1,763	1,897	2,023
Furnace fuel	'000 tons	4,869	5,340	5,759	6,206	6,113
Automotive distillate	"	1,603	1,829	2,167	2,344	2,579
Industrial diesel fuel	"	862	859	901	984	1,038
BUILDING MATERIALS						
Clay bricks	millions	1,353	1,360	1,361	1,440	1,612
Portland cement	'000 tons	3,746	3,688	3,661	3,805	3,978
Plaster of paris	"	277	266	261	278	282
Plaster sheets	'000 sq yd	29,937	29,917	30,601	32,809	35,291
CHEMICALS						
Sulphuric acid	'000 tons	1,635	1,781	1,991	1,892	1,853
Caustic soda	tons	68,879	75,229	91,009	98,190	105,478
Superphosphate	'000 tons	3,703	4,265	4,430	3,935	3,938

(a) Excludes secondary metal with exception of 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 1967 to 1968-69 are shown in the following table.

**EXPORTS AND IMPORTS OF PRINCIPAL MINERALS AND MINERAL PRODUCTS
AUSTRALIA, 1967, 1968 AND 1968-69**

Commodity(a)	Quantity			Value (\$'000 f.o.b.)			
	1967	1968	1968-69(b)	1967	1968	1968-69(b)	
EXPORTS(c)							
Alumina	tons	n.a.	n.a.	n.a.	29,489	60,454	75,806
Aluminium and aluminium base alloys—							
Unworked shapes	"	10,501	5,577	8,226	4,926	2,745	4,304
Rolled, drawn and extruded shapes	"	4,835	3,985	2,704	3,304	2,449	1,850
Coal	"	9,250,297	12,096,102	13,814,749	76,203	103,745	117,103
Copper—							
Ore and concentrate	"	44,830	36,494	41,073	9,526	8,657	9,769
Blister	"	6,893	7,063	7,551	8,627	9,459	9,938
Ingots, pigs (refined)	"	9,325	16,518	26,649	8,975	16,810	27,337
Rolled, drawn and extruded shapes	"	7,043	7,164	10,101	8,102	8,381	11,645
Gold, refined	fine oz	537,922	385,976	447,929	16,942	13,126	15,894
Ilmenite concentrate	tons	384,300	395,911	495,231	3,896	4,090	5,229
Iron and steel—							
Iron ore	"	9,017,084	16,134,492	20,071,987	75,372	139,816	179,515
Pig iron	"	149,587	241,869	346,183	6,169	8,925	13,105
Ingots, blooms and slabs	"	398,635	470,527	424,838	23,719	27,474	23,858
Tinplate	"	56,252	42,576	44,029	7,452	5,359	5,410
Scrap	"	475,056	401,801	481,982	14,226	10,389	11,751
Lead—							
Ore and concentrate	"	124,016	121,122	113,343	23,166	23,636	22,020
Lead-silver bullion	"	100,394	107,325	126,348	26,901	34,457	39,262
Pig	"	147,558	137,542	115,415	30,282	28,419	24,994
Manganese ore	"	314,762	555,743	629,531	6,933	10,827	11,837
Opals . . . . .	"	..	..	..	8,635	10,653	11,883
Petroleum oils—							
Gasolines and solvents	'000 gal	55,593	90,814	67,698	6,582	10,075	7,412
Kerosenes	"	21,655	31,815	19,558	2,553	3,720	2,367
Automotive distillate, industrial and marine diesel fuels and heavy distillate, n.e.i.	"	62,964	62,677	48,291	5,310	5,467	4,225
Residual oils	"	123,441	98,553	70,289	8,925	6,291	3,984
Lubricating oil	"	28,664	21,703	24,804	8,577	6,707	7,497
Rutile concentrate	tons	258,791	284,995	286,080	19,692	21,865	22,844
Silver—refined ingot bar	fine oz	5,249,220	15,812,371	11,666,551	7,173	31,705	21,695
Tin ores and concentrates	tons	3,452	5,366	6,387	4,567	7,574	8,959
Tungsten concentrates—							
Scheelite concentrate	"	1,239	1,434	1,771	3,316	3,532	4,407
Wolfram concentrate	"	399	497	679	1,096	1,294	1,929
Zinc—							
Ore and concentrate	"	297,927	321,027	332,619	19,873	21,660	21,820
Refinery type shapes	"	96,471	97,177	115,562	23,562	22,597	27,291
Zircon concentrate	"	247,179	266,121	295,989	10,720	11,013	11,952
IMPORTS							
Alumina	tons	37,047	2,964	2,972	2,543	551	504
Aluminium, refined ingots	"	361	11,975	11,160	232	5,822	5,437
Asbestos	short "	52,584	66,741	59,962	6,435	8,318	7,628
Diamonds—							
Gemstone	m carat	27,520	31,499	35,526	4,301	4,727	5,246
Industrial	"	525,053	669,931	461,321	1,980	2,725	2,299
Gold, unrefined bullion(d)	fine oz	128,127	122,758	114,276	4,019	4,133	4,075
Ferro-alloys	tons	23,491	23,418	22,188	6,689	6,401	5,316
Nickel—pig, ingot anodes	tons	1,536	1,914	1,784	3,068	3,848	3,554
Petroleum oils—							
Crude	'000 gal	4,038,853	4,202,570	4,297,344	167,008	169,892	174,792
Enriched crude and other refinery feedstock	"	999,338	956,716	874,342	43,976	43,100	39,453
Gasolines and solvents	"	141,888	158,605	148,814	13,949	15,379	13,650
Kerosene	"	33,563	29,118	29,306	3,515	3,146	3,116
Automotive distillate, industrial and marine diesel fuels and heavy distillate, n.e.i.	"	18,370	44,250	54,421	1,578	3,610	4,336
Residual oils	"	23,973	32,249	137,431	1,149	1,522	5,668
Lubricating oil	"	11,363	12,121	10,821	3,565	3,664	3,407
Phosphate rock	'000 tons	3,265	3,431	3,177	30,355	34,140	31,606
Potassium fertilisers	"	114,313	137,584	134,933	3,752	3,632	3,457
Sulphur	"	513,962	548,563	394,987	17,296	21,632	15,434
Tin, refined	"	693	159	143	2,066	448	415
Titanium oxide (pigments)	"	1,110	1,527	1,385	449	604	566

(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) Year ended 30 June. (c) Australian produce. (d) 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 1968-69 and their principal metallic content as estimated by assay.

**PRINCIPAL METALLIC CONTENTS OF SELECTED ORES AND CONCENTRATES
ETC., EXPORTED FROM AUSTRALIA, 1968-69**

Ores and concentrates, etc.	Metallic contents—estimated from assay								
	Copper	Lead	Zinc	Tin	Iron	Manganese	Tungstic oxide(a)	Gold	Silver
	tons	tons	tons	tons	'000 tons	tons	units	fine oz	'000 fine oz
Copper concentrate	9,656	..	..	41	..	..	..	17,206	115
Blister copper	7,519	..	..	..	..	..	..	60,094	36
Copper matte, slags, etc.(b)	1,513	4,275	..	54	..	..	..	32	203
Lead concentrate	1,371	76,529	6,690	..	..	..	..	25,170	2,479
Lead-silver bullion . . . . .	..	120,490	..	..	..	..	..	..	8,737
Lead slags and residues	273	2,500	13	98	..	..	..	..	..
Zinc concentrate	6	2,075	171,122	..	..	..	..	..	370
Zinc slags and residues	6	23	4,166	3	..	..	..	..	..
Tin concentrate	8	1	..	3,627	..	..	..	..	..
Iron ore—	..	..	..	..	..	..	..	..	..
Pellets . . . . .	..	..	..	..	2,808	..	..	..	..
Fines . . . . .	..	..	..	..	1,320	..	..	..	..
Lump . . . . .	..	..	..	..	8,976	..	..	..	..
Manganese ore . . . . .	..	..	..	..	..	254,908	..	..	..
Scheelite concentrate . . . . .	..	..	..	..	..	..	120,097	..	..
Wolfram concentrate . . . . .	..	..	..	..	..	..	49,800	..	..
Total metallic content	20,352	205,893	181,991	3,823	13,103	254,908	69,897	102,502	11,948

(a) 1 unit = 22.4lb.

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

**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 1970, with the preliminary value of mineral production increasing by 25 per cent from \$1,142 million in 1969 to \$1,425 million in 1970. 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 black coal in New South Wales and Queensland. The total value of mineral exports continued to increase, mainly because of the increase of iron ore and coal shipments to Japan.

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 1970 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 1970 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 2.3 million tons from Weipa were used by the Gladstone, Queensland, alumina refinery in 1970, 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 mid-1972. The alumina refinery at Kwinana, Western Australia, was expanded from 817,000 tons to 1,024,000 tons annually by July 1970 and to 1,230,000 tons by the end of 1970. Bauxite supplies for the Kwinana refinery are obtained from deposits 28 miles away at Jarrahdale, Western Australia, the reserves of which are assessed as 500 million tons. A new alumina plant will also be commissioned at Pinjarra, Western Australia, in mid-1972, with an initial production capacity of 413,000 tons yearly.

Aluminium

Operating capacity of the smelter at Kurri Kurri, New South Wales, was steadily increased during 1970, and was scheduled to reach 44,600 tons annually by the end of that year, and the smelter will be expanded to 100,000 tons following the signing of an agreement with Kobe Steel Ltd for the supply of aluminium ingots. 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 smelter at Bell Bay was increased to 94,000 tons per annum in early 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 \$10 million, will have an installed mining capacity of 400,000 tons of ore per annum. Production commenced in mid-1971.

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 1970, after reaching a record 73 cents per pound (\$1,685.2 per long ton) in March, the Australian price eased to 61 cents (\$1,366.4 per long ton) by mid-June. It continued a downward trend throughout the latter half of the year and stood at 44 cents (\$985.6 per long ton) on 31 December.

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 1970 to Japan and elsewhere were 40.4 million tons valued at \$325 million.

At Mount Tom Price, Western Australia, iron ore production capacity is being expanded from a 1970 level of 17.5 million tons per year to a level of 22.5 million tons per year by the end of 1971. At Paraburdoo, 35 miles south of Mount Tom Price, development of iron ore deposits is being accelerated so that the mine will be capable of producing at a rate of 5 million tons of ore per year by 1972 and 15 million tons per year by the end of 1972. Port capacity at Dampier, Western Australia, is to be expanded to handle the increased ore production from Mount Tom Price and the new production from Paraburdoo.

Shipments of iron ore from Mount Newman, Western Australia, commenced through Port Hedland in April 1969. As announced in 1970 capacity is being increased to enable ore to be mined and shipped at a rate of 25 million tons per year by 1972 and 30 million tons per year by 1974.

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 Kennedy Gap 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 mid-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.

Firm plans are in hand for the construction at Dampier, Western Australia, of a plant to produce metallised agglomerates. Early in 1970 it was announced that letters of intent had been signed for the purchase by Japanese buyers of 6.5 million tons of agglomerates. Delivery is proposed over 10 years from April 1973.

Lead and zinc

Following record mine production of lead and zinc in 1969, resulting from completion of major mine expansion programmes at Mount Isa, Queensland, and Broken Hill, New South Wales, output of both metals was marginally lower in 1970 but in both cases well above the level of mine production in 1968. Mine production of lead was 442,800 tons, and of zinc 476,000 tons in 1970. Production of lead bullion at Mount Isa, and Cockle Creek, New South Wales, in 1970 was 169,700 tons, nearly 11 per cent higher than in 1969, but production of refined lead at Port Pirie, South Australia was cut back from 195,300 tons in 1969 to 187,800 tons in 1970 in response to the weakening world demand. Total production of refined zinc from Risdon, Tasmania, Port Pirie and Cockle Creek in 1970 was 256,478 tons, nearly 6 per cent higher than in 1969.

Further increases in production of zinc concentrates and refined zinc will result from a current programme of expansion at the Rosebery mine in Tasmania, a new mine at Beltana, South Australia, and expansion of the Risdon refinery. Expansion of existing electrolytic refining facilities and a new residue treatment plant at Risdon will increase capacity to 210,000 tons of zinc per annum by mid-1972. A decision to reduce production of crude lead at Mount Isa was announced early in 1971 and commencement of sinking one of the two major shafts at the new Hilton mine has been deferred until 1973. The Hilton mine is expected to become a major producer of lead and zinc in the late 1970's.

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 1970 exports were 18.0 million tons valued at \$177.2 million. These increased exports have been almost wholly 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 1970, there were five Australian oil fields in production, namely, Moonie and Alton Queensland; Barrow Island, Western Australia; and Barracouta and Halibut in the Gippsland Shelf area offshore from Victoria. Another major field, Kingfish also in the Gippsland Shelf area, was being drilled for production at the end of 1970. 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. The production of crude oil in 1970 from the Australian oil fields was 65,191,269 barrels representing 36 per cent of the country's requirement of refinery feedstock. The cumulative production of crude oil to 31 December, 1970 amounted to 111.5 million barrels.

In 1970, additional discoveries were made in the Cooper Basin in South Australia at Della, Strzelecki, Moorari, Packsaddle, Mudrangie, Yanpurra; at Palm Valley No. 2 and Petrel No. 1 in the Northern Territory, and at Noorindoo and Kincora in the Surat Basin, Queensland. The provisional figure for footage drilled in petroleum exploration and development in Australia in 1970 was 1,237,335 feet which is some 105,000 feet less than the footage drilled in the previous year. About 728,974 feet of the 1970 total was attributed to exploration drilling of which 255,487 feet were drilled offshore. A total of 212 wells was completed in 1970, of which 120 were exploration wells, 27 of them offshore. In comparison with the previous year there was an increase of some nine exploration wells and a decline of 119 development wells in 1970.

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 1970 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. Subject to the success of current pilot plant tests, construction of a railway and an ammonia leach treatment plant at Townsville, northern Queensland, is expected to commence in mid-1971. 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.

