CHAPTER 16

MINERAL INDUSTRY

GENERAL

Geology and mineral resources

General geology

Most of the western and central part of the Australian continent consists of basement rocks of Precambrian age. Younger Palaeozoic rocks, mostly of geosynclinal origin, form a discontinuous belt several hundred kilometres 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, southwestern 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: one of Precambrian rocks in the west and central areas of the continent; and one of younger Palaeozoic rocks in the east.

Mineral resources

Australia is self-sufficient in most minerals of economic importance (and much more than selfsufficient in some). Known adequate reserves of minerals with production sufficient for domestic demand and exports include aluminium (bauxite), black coal, copper, gold, iron ore, lead, natural gas, nickel, salt, silver, tin, tungsten, uranium and zinc. Adequate reserves sufficient for domestic demand include clays (except light grade china clay), brown coal, dolomite and felspar.

For further details of principal Australian mineral deposits, and notes on principal mineral resources, see Year Book No. 61, pages 925–932.

Administration

All mineral rights in Australia are vested in the Crown except those on land which was granted before the Crown began to reserve mineral rights. In practice, these private mineral rights are important only in the New South Wales coalfields. In the States, these rights are held by the State Governments. On 1 July 1980, executive authority with respect to mining and minerals except in relation to certain prescribed substances within the meaning of the Atomic Energy Act (principally uranium) was transferred from the Commonwealth Government to the Northern Territory Government. Private mineral rights in the Australian Capital Territory 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 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 different in detail. They all make provision for a miner's right to prospect and for small mining leases for mineral production. The principles embodied 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 negotiations 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). Mining legislation enacted in recent years is simpler and more suited to modern conditions.

Control of mineral 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 airborne 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 (usually 50 per cent) as a result of work done during the life of the initial agreement. It does not give the holder any rights over, or authority to prospect on, land already held under a mining title within the agreed area. Unless specifically stated in an agreement, the discovery of minerals, whether inside or outside an area covered by an authority to prospect, gives the discoverer no legal rights except the right to apply for a mining lease over the area in which the discovery was made. Suitable prospects are converted to mining tenements by making application for lease under the appropriate mining Act.

Control of petroleum exploration

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

- There are three main types of petroleum title:
- (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.

Off-shore. Following the enactment of the *Seas and Submerged Lands Act* 1973 the High Court confirmed that the Commonwealth has sovereign rights over the resources of the whole of Australia's continental shelf. However in the offshore constitutional settlement between the Commonwealth and the States reached in June 1979, it was agreed that responsibility for administering petroleum exploration and production within the outer boundary of the 3 mile territorial sea should stay with the States, while the Commonwealth should have responsibility for areas beyond.

Amendments to the *Petroleum (Submerged Lands) Act* 1967 passed by the Commonwealth Parliament in May 1980 made provision for a Joint Authority for the adjacent area of each State (beyond the 3 mile Territorial Sea limit) consisting of the Commonwealth Minister and the State Minister. The Joint Authorities will be concerned only with major matters arising under the legislation, and in the case of disagreement the view of the Commonwealth Minister will prevail. Day-to-day administration will continue to be in the hands of the State Minister as the Designated Authority and State officials. The amended legislation will be proclaimed to come into effect when complementary State legislation in respect of the 3 mile Territorial Sea, currently in preparation, is enacted. In the meantime administration of offshore petroleum continues to be carried out under the 1967 legislation.

The mining code applicable under the 1967 legislation and the mining code to be applied under the future arrangements provide 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. The sharing of royalty between the State and the Commonwealth Governments is to continue on a 60:40 basis; and any override royalty payments will continue to be retained by the States.

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 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 following table.

(5'00)										
	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79				
New South Wales(a)	13,496	37,864	32,660	46,354	49,062	35,651				
Victoria(b)	23,922	26,657	29,893	32,696	48,446	60,111				
Queensland(a)	4,319	34,867	36,753	50,842	53,651	57,981				
South Australia	1,944	2,500	2,788	3,346	4,109	4,543				
Western Australia	33,615	39,385	43,111	51,638	54,519	57,810				
Tasmania	506	342	576	1,496	2,093	2,193				
Northern Territory(c)	242	99	545	362	277	120				
Commonwealth Government (d)	10,786	12,155	13,440	13,805	23,002	28,031				
Total	88,831	153,869	159,766	200,539	235,159	246,440				

MINERAL ROYALTY RECEIPTS: GOVERNMENTS

(a) Includes royalty on sand and gravel from Crown lands. (b) Includes royalty on brown coal paid by State Electricity Commission. (c) Excludes Aboriginal Benefits Trust Fund royalties from mining operations for which details are not available. (d) Includes royalties received under the Petroleum (Submerged Lands) (Royalty) Act 1967.

Control of Exports

The Commonwealth Government has constitutional power over exports from Australia. Under the Customs (Prohibited Exports) Regulations exports of nuclear sensitive material, hydrocarbons and certain raw or semi processed minerals are prohibited unless permission is granted by the Minister for Trade and Resources or an authorised person.

The fundamental objectives of the controls are:

- (i) to protect the national interest and ensure fair and reasonable market prices are achieved;
- (ii) to ensure adequate supplies are available for the domestic market;
- (iii) to meet international and strategic obligations; and
- (iv) to ensure the Government's nuclear safeguards and physical protection requirements on exports are met, consistent with Australia's international obligations in relation to uranium and nuclear materials.

Export controls are administered on coal, iron ore, bauxite, alumina, petroleum and petroleum products, tin, salt, uranium and materials of nuclear significance. Controls on tin concentrates are being phased out over calendar years 1980 and 1981, except for International Tin Agreement purposes.

Ores, concentrates, oxides, etc. of nickel, lead, zinc, copper, manganese, tungsten, bismuth and blister and refined copper are subject to blanket approvals.

With regard to mineral sands, approvals to export are freely issued except where the Commonwealth considers there are environmental reasons which would make such exports undesirable. Exports of copper scrap and copper alloy scrap are embargoed and quotas apply to secondary copper ingots and basic shapes made from scrap material. All other minerals are not subject to control.

Joint Coal Board

The Joint Coal Board was established in 1946 under joint legislation of the Commonwealth Government and of the State of New South Wales to carry out special administrative functions in regard to the New South Wales black coal mining industry. In summary, the Board's functions are:

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

Queensland Coal Board

The Queensland Coal Board has functions similar to those of the Joint Coal Board. It also carries out research and sampling tests of Queensland coals. It makes funds available to colliery proprietors for equipment and makes grants and/or loans for the provision of amenities for employees and for communities in coal mining districts. The price fixing of coal sold within Queensland is another important function.

Australian Atomic Energy Commission

For details of the functions of the Australian Atomic Energy Commission see Chapter 18, Energy.

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 on the following pages.

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 (BMR) and the Commonwealth Scientific and Industrial Research Organization (CSIRO).

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

Special deductions for capital expenditure incurred in the discovery and mining of petroleum (including natural gas) are allowable to a petroleum mining enterprise engaged in these operations in Australia. Capital expenditure allowable to petroleum mining enterprises includes, broadly, the costs of exploratory surveys, drilling and well-head plant; plant for the liquefaction of natural gas; and of access roads and expenditure on housing and welfare. The enterprise is entitled to these special deductions against income from any source. While the special deductions for exploration expenditure are deductible immediately against the net income of the enterprise, the deductions for capital expenditure on development are allowable over the life of the oil or gas field or over five years, whichever is less on a reducing balance basis.

An enterprise 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 enterprise, other than costs of exploration, may be deducted against income from any source over the life of the mine, or over five years, whichever is the less. Expenditure incurred by a mining enterprise in exploring for general minerals is allowable as an immediate deduction against net income derived from mining operations. Annual deductions for depreciation on petroleum mining plant or general mining plant may be allowed in lieu of spreading the cost over the life of the oil field or mine. The cost of exploration plant may also be deducted under the depreciation provisions of the law. The investment allowance scheme may permit a deduction at the rate of 20 per cent of the cost of certain new plant.

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, pipeline or similar transport facility and on certain port facilities or other facilities for ships. Allowable expenditure on transport facilities is deductible in equal annual instalments over a period of ten or twenty years at the option of the mining enterprise.

An income tax rebate of 30 cents for each dollar of share capital subscribed may be available to shareholders of petroleum mining companies exploring or mining for petroleum in Australia, including off-shore areas, where those companies lodge appropriate declarations with the Commisioner of Taxation in respect of the moneys subscribed. By lodging those declarations, certifying that the capital subscriptions have been, or will be, spent on eligible outgoings within a specified period, the petroleum mining companies forgo deductions to which they might otherwise be entitled for capital expenditure.

Petroleum search subsidy. The Petroleum Search Subsidy Scheme, introduced in 1957, was terminated on 30 June 1974. For details see Year Book No. 61, pages 936-7. Pricing of Australian crude oil. In August 1977, the Commonwealth Government announced new arrangements in the pricing, allocating, and levying arrangements of crude oil. These will take the price of indigenous crude oil from presently known fields in the direction of import parity. This will be achieved through a uniform method of price determination. The new scheme, which took effect from 17 August 1977, applies to each known field in Australia.

Producers receive the import parity price for a specified part of their production. Import parity is received for either the first 6 million barrels of oil produced from each field per annum, or for a proportion of production per annum which will be increased over time according to a specified schedule, whichever is the greater in any particular case. The schedule is 10 per cent from 17 August 1977 until the end of the 1977-78 financial year, rising to 20 per cent for the financial year 1978-79, 35 per cent for 1979-80 and 50 per cent for 1980-81. The phasing-in will then continue only for fields producing less than 15 million barrels per annum. For all additional production from each field or new development, the producers receive the price which was current up to the time of the introduction of the new arrangements, i.e. \$2.33 per barrel in the case of the Bass Strait fields, and \$2.88 per barrel in the case of the Barrow Island field. All production from the Moonie and Alton fields and other small fields will, in practice, receive import parity prices, as the output from those fields is well below 6 million barrels per annum.

The Government will review the position before June 1981 to decide the rate at which the further progression to full import parity should take place for presently known fields. Oil from fields discovered after 14 September 1975 will continue to receive full import parity.

The import parity price will be set every six months by the Commonwealth Government and will be calculated on the basis of the price of Arabian light oil at the nearest refinery port, adjusted to allow for an appropriate quality differential. This differential will take account of the suitability of indigenous crude oil for the local market. For the period after 1 July 1979, the import parity price is set at \$18.66 per barrel for Bass Strait crude oil, \$18.84 for Barrow Island crude, and \$19.71 for Moonie crude delivered to Westernport, Kwinana, and Brisbane/Roma respectively.

Oil Supply Emergencies

The National Petroleum Advisory Committee (NPAC) was established in September 1979, to advise Commonwealth, State and Territory Governments on:

- appropriate arrangements for the equitable allocation of liquid fuels, during any period of supply shortage.
- priorities for the allocation of liquid fuels during periods of shortage.

The 22-man membership of NPAC is drawn from agricultural, general aviation, fishing, manufacturing, mining, shipping and transport industries, oil industry, trade union movement and motorists organisations as well as Commonwealth, State and Territory Governments. The Department of National Development and Energy provides the Secretariat for NPAC.

Payments to producers of phosphate fertilisers. The Phosphate Fertilisers Bounty Act 1963 provides for a bounty to be paid on phosphatic substances produced and sold in Australia as a fertiliser. Phosphatic substances used as a supplement to stock food are also regarded as being used as a fertiliser. Bounty is payable at the rate of \$12 per tonne in respect of superphosphate where the available phosphorus content is not less than 8.5 per cent or more than 8.9 per cent by weight. Outside this range, bounty is payable at \$138 per tonne of the available phosphorus content of the substance. The intention of the Act is to assist consumers of phosphate fertilisers (primary producers). The Act expires on 30 June 1982.

Bureau of Mineral Resources, Geology and Geophysics. The role of BMR is:

- (i) to develop an integrated, comprehensive, scientific understanding of the geology of the Australian continent, the Australian offshore area and the Australian Antarctic Territory, as a basis for minerals exploration; this to be done where appropriate in co-operation with State Geological Surveys and other relevant organisations and having regard to priorities for the search for minerals approved by the Minister for National Development and Energy;
- (ii) to be the primary national source of geoscience data and to publish and provide information; and
- (iii) to undertake mineral resource assessments in accordance with programs and priorities approved by the Minister for National Development and Energy with the advice of the BMR.

The BMR comprises five branches under the Director: Operations, Mineral Resources, Geological, Geophysical, and Petroleum Exploration. The Operations Branch consists of five sections : Planning and Co-ordination, Publications and Information, Automatic Data Processing Applications, Cartography and Administrative. It carries out central office functions, including planning and control of program, assessment of results, co-ordination of activities, liaison, distribution of information and provision of ADP and cartographic services. The Mineral Resources Branch comprises the sections Mineral Economics and Mining Engineering and is concerned largely with those aspects of the BMR's work

which involve studies of the mineral industry as a whole, including the assessment of Australia's mineral resources 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 BMR and the operation of observatories. The Petroleum Exploration Branch is concerned with the technical administration of the *Petroleum (Submerged Lands) Act* 1967, the assessment of sedimentary basins in Australia and its Territories, and monitors the level of petroleum exploration, development, and production activity and associated economic factors. At 30 September 1980, 502 officers were employed at the BMR, this included 202 professional officers (geologists, geophysicists, chemists, engineers and mineral economists).

The BMR maintains laboratories in Canberra engaged on geochemical, geochronological and petroleum technological studies and basic research into the design and testing of geophysical equipment. It also maintains geophysical observatories at Kowen Forest (Australian Capital Territory), Mundaring (Western Australia), Mawson (Antarctica), and Macquarie Island. The geophysical observatories are engaged in geomagnetic, ionospheric, and seismology 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 generally give a free technical service to the mining industry.

New South Wales. The Department of Mineral Resources renders scientific, technical and financial assistance to the mining industry. Grants are made to cover up to half the cost of prospecting and drilling operations. These grants are repayable if sufficient payable minerals are discovered or if certain other conditions are met. A quantity of equipment is also available for hire in several localities. The Department has itself undertaken a program of contract drilling to investigate the existence of mineral deposits in the State (including the testing and proving of coal resources). Expenditure on exploration and prospecting in 1978–79 amounted to \$974,710, including \$306,339 on grants and \$586,711 on the Department's own drilling program.

Victoria. The Department of Minerals and Energy comprises the Divisions of Administration, Energy, Geological Survey, Hazardous Materials, Oil and Gas, Mining. These divisions conduct geological and mineral surveys and produce geological maps, and issue scientific and technical reports thereon. Rotary, percussion and auger drilling operations are carried out and the results are used in sedimentary basin studies and 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, pipeline, mining and extractive industry legislation by the various Divisions of the Department ensures that petroleum exploration and production (both on-shore and off-shore), mining and quarrying are carried on in a safe and effective manner. Technical assistance and limited loans and grants are available for mineral exploration and prospecting and for approved development operations. Five stamp batteries located throughout the State provide an ore-crushing service to enable test crushings to be made at nominal cost. Information is available on mining law and mineral statistics. Assays of ores, analytical services, advice on metallurgical treatments, industrial pollution and chemical problems are available, together with information on the manufacture, handling and use of explosives and inflammable liquids. Financial assistance is available to municipalities to reclaim mine-damaged land in areas where a reclamation committee recommends such action.

Queensland. The Department of Mines provides assistance to mining by way of geological services, grants for construction and maintenance of roads in mining areas, repayable advances or subsidies for mine development, hiring and equipment, and assistance to prospectors. The Department maintains a concentration plant for tin ores at Irvinebank, an assay office at Cloncurry and diamond drilling plants in various parts of the State. The Queensland Coal Board carries out research and sampling tests of Queensland coals. It also makes funds available to colliery proprietors for equipment and makes grants and/or loans for the provision of amenities for employees and for communities in coal mining districts.

South Australia. The Department of Mines and Energy has as its principal functions the administration of mining and petroleum legislation including the granting of mineral leases and collection of royalties and fees; geological and geophysical investigations to ascertain the extent and nature of the State's mineral resources; drilling to test mineral deposits, petroleum reserves and underground water supplies; the testing and treatment of minerals, generally in arrangement with the Australian Mineral Development Laboratories; control of mining and rehabilitation; co-ordinating State Government activities and formulating policy advice in the discovery, assessment and development of all energy resources within the State.

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 fifteen State batteries operating intermittently throughout the goldfields for the treatment of ore from prospectors and small mine owners at a nominal charge. A cartage subsidy is also granted to such operators sending gold and lead ores to State batteries for treatment. Provision is made for loans to mine-owners who require assistance to develop mines.

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

Northern Territory. The Department of Mines and Energy provides a wide range of services through its Geological Survey and Mines Division. The Division is examining the regional geology and geophysics of the Territory, with a view to facilitating the search for mineral, energy and ground water resources. It provides geological and geophysical advice, undertakes and promotes research into new techniques for mapping, geophysical surveys and mineral search. A Technical Library service is provided in Darwin and Alice Springs. Drill cores and cuttings are maintained at Darwin, Alice Springs and Tennant Creek.

The Mines Division provides expertise in mining, occupational hygiene, environment protection, metallurgy, economics and assaying. Services include plants at Mount Wells and Tennant Creek to process ore at subsidised rates; hire of mining equipment at nominal rates; funding of mine access road construction and maintenance, water supply, drilling, mine development and ore haulage; advice on mining techniques, mineral processing, project assessment, finance and marketing.

Rehabilitation of abandoned mine areas and preservation of historical mine items are programmed.

Research

Research investigations into problems of exploration, mining, ore-dressing and metallurgy are conducted by Government bodies, by universities, by private enterprise, and by combined efforts of these bodies. A summary of their functions follows. (For further information on research *see* Chapter 25, Science and Technology).

Australian Atomic Energy Commission

For a more detailed description of the activities of the Australian Atomic Energy Commission see Chapter 18, Energy.

The Australian Mineral Development Laboratories

Technical consulting, contract research and process design 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, petrology, chemical metallurgy and mineral engineering, process instrumentation and control, water and waste water treatment and materials technology. Both long and short term applied research is carried out and all investigations are conducted on a strictly confidential basis. Services in the field of pollution and environmental control are also available through the Amdel group, Amdel (Aspect).

The Baas Becking Geobiological Research Laboratory

In 1965, the Baas Becking Geobiological Research Laboratory was established in the Bureau of Mineral Resources building in Canberra under the joint sponsorship of the Commonwealth Scientific and Industrial Research Organization, the Bureau of Mineral Resources, and the Australian Mineral Industries Research Association (*see* Research by private enterprise, page 418).

Much of the biological research has involved studies on the biology and biochemistry associated with mineralisation processes. The expertise gained is applied to the investigation of biogeological controls on base metal sulphide mineralisation. On the geological side, research is co-ordinated with the field programs of the Bureau of Mineral Resources, and includes studies on the McArthur Basin, the Adelaide Geosyncline and the Pine Creek Geosyncline.

Bureau of Mineral Resources, Geology and Geophysics

The Bureau of Mineral Resources is the largest geoscience research organisation in Australia. Its role is to develop an integrated scientific understanding of the geology of the Australian continent, its Territories and offshore areas, as a basis for mineral exploration and resource assessment. BMR's activities include:

- Basic geochemical, petrological and mineralogical studies of sedimentary and igneous environments of metalifferous deposits and of the deposits themselves including the study of particular genetic groups of mineral deposits on a continental-wide basis;
- Studies of the characteristics and origin of fossil fuels.
- Multidisciplinary studies of metallogenic provinces, of sedimentary basins (including offshore basins), and of those geological systems which have continental development in Australia and which may, on evidence worldwide, be hosts to major mineral deposits or to fossil fuels.
- Studies of the effect of surface processes on the bedrock of the Australian continent in relation to their effect on exploration techniques and to their importance for uranium, water and lateritic accumulations.
- Geophysical studies of the structure of the crust and upper mantle relevant to the understanding of the evolution of the Australian continent and its mineral deposits.
- Studies in exploration geophysics, including remote sensing and airborne radiometric and magnetic surveys and their interpretation.
- Marine geophysical surveys and their geophysical and geological interpretation.
- Assessment of resource potential for minerals.
- Assessment of resource potential for fossil fuels.
- Development and maintenance of a national geoscience data base.

For details of the functions of the Bureau of Mineral Resources, Geology and Geophysics, see page 385.

Commonwealth Scientific and Industrial Research Organization

Mineral research by the Commonwealth Scientific and Industrial Research Organization (CSIRO) is undertaken mainly within the Institute of Earth Resources with the objective of contributing to the location, extraction and processing of minerals through development of procedures which are efficient and economic and involve safe working practices which do not impose irreparable damage on the environment. The Divisions and independent units in the Institute engaged in mineral research are the Division of Applied Geomechanics at Syndal (Vic.), the Fuel Geoscience Unit at North Ryde (N.S.W.); the Division of Mineral Chemistry at Port Melbourne (Vic.); the Division of Mineral Engineering at Clayton (Vic.); the Division of Mineral Physics at North Ryde (N.S.W.) and Port Melbourne (Vic.), the Physical Technology Unit at Ryde (N.S.W.); and the Division of Process Technology at North Ryde (N.S.W.).

Department of National Development and Energy

The National Coal Research Advisory Committee which was established in 1964 no longer exists. Its functions have been incorporated into the National Energy Research, Development and Demonstration Council (NERDDC) which is administered by the Department of National Development and Energy. For details of NERDDC and the National Energy Advisory Committee (NEAC), which advises the Minister for National Development and Energy on matters relating to national energy policy *see* Chapter 18, Energy and Chapter 25, Science and Technology.

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

Many of the large companies in the mineral industry conduct their own research in dealing with their particular Company's interests. In 1959 the major companies in the industry, formed the Australian Mineral Industries Research Association Limited to co-ordinate and manage sophisticated research programmes on a co-operative basis, carried out by the Australian Mineral Development Laboratories, CSIRO, Universities and by other research organisations.

Since then, the research activity has grown considerably in magnitude and currently involves many of the seventy five companies which comprise the Company, Associate and Division members within the Association.

Fields of research cover geology, ore genesis and exploration techniques, mining and rock mechanics, mineral processing, ecology, energy, analytical methods and miscellaneous other items and the expenditure in these fields in 1979-80 was approximately \$1,550,000.

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. It was followed by the Second, Third, Fourth and Fifth International Tin Agreements, which came into force on 21 February 1962, 21 March 1967, 1 July 1971 and 1 July 1976 respectively. Australia joined the Fourth and Fifth Agreements as a 'producing' (i.e. exporting) member, whereas in the first three agreements Australia's status had been that of a 'consuming' (i.e. importing) member. Details of the Second and Third Agreements are given in Year Book No. 57, pages 911-12. Details of the Fourth Agreement are given in Year Book No. 61, page 942.

The objectives and provisions of the present (Fifth) Agreement are essentially the same as for its predecessors. The International Tin Agreement establishes floor and ceiling prices for tin and, by the medium of a buffer stock and remedial trading, aims at confining the prices within these limits. Producing countries are required to contribute to a buffer-stock equivalent in cash or tin up to 20,000 tonnes of tin metal, which is used to buffer short-term fluctuations in the world price market. In addition, consuming countries may also make contributions in either cash or tin metal up to the equivalent of 20,000 tonnes of tin metal. In the event of persistent market disequilibrium through causes beyond the control of the buffer stock mechanism, the agreement also provides for the regulation of exports and stocks to stabilise the market.

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

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, Germany (Federal Republic of), Hungary, India, Ireland (Republic of), Italy, Japan, Mexico, Morocco, Netherlands, Norway, Peru, Poland, South Africa (Republic of), Spain, Sweden, Tunisia, Union of Soviet Socialist Republics, United Kingdom of Great Britain and Northern Ireland, United States of America, Yugoslavia and Zambia. The Group provides opportunities for inter-governmental consultations on international trade in lead and zinc and for studies of the world situation in lead and zinc having regard especially to the desirability of providing continuous, accurate information regarding the supply and demand position and its probable development.

Association of Iron Ore Exporting Countries (APEF)

Australia is a founder member of the Association of Iron Ore Exporting Countries (APEF). Other members include Algeria, India, Liberia, Mauritania, Peru, Sierra Leone, Sweden and Venezuela.

The objectives of the Association are to promote close co-operation among Member countries with a view to safeguarding their interests in relation to the iron ore export industry; to ensure the orderly and healthy growth of export trade in iron ore; to assist Member countries to secure fair and remunerative returns from the exploitation, processing and marketing of iron ore and to provide a forum for consultations and the exchange of information on problems relating to the iron ore export industry.

Although meetings of the Association have been mainly concerned with administrative matters, it has been agreed that the Secretariat's work programme should give priority to the preparation of statistical material. The Association has also discussed the attitudes of APEF members to iron ore matters raised under the UNCTAD Integrated Programme on Commodities.

Intergovernmental Council of Copper Exporting Countries (CIPEC)

The CIPEC was established in 1967 by the Governments of Chile, Peru, Zaire and Zambia as an intergovernmental consultative organisation.

Australia and Papua-New Guinea were admitted as Associate Members and Indonesia as a Full Member in 1975; Yugoslavia was admitted as an Associate Member in 1977. Associate Members may participate in meetings but have no voting rights and are not bound by CIPEC's decisions.

The key objectives of CIPEC are to co-ordinate measures to achieve continuous growth in real earnings from copper exports and to harmonise the decisions and policies of members relating to copper production and marketing.

International Bauxite Association

Australia joined the International Bauxite Association (IBA) as a founder member in October 1974. Other members are Dominican Republic, Ghana, Guinea, Guyana, Haiti, Indonesia, Jamaica, Sierra Leone, Surinam and Yugoslavia. Members account for about three-quarters of world bauxite production with Australia accounting for nearly one third of world production.

The objectives of the Association are to promote the orderly and rational development of the bauxite industry; to secure for members fair and reasonable returns from the exploration, processing and marketing of bauxite and its products for the economic and social development of their peoples, bearing in mind the recognised interests of consumers; and generally to safeguard the interests of member countries in relation to the bauxite industry.

The Association consists of a Council of Ministers which meets once a year and is the supreme organ, an Executive Board consisting of senior officials which meets three times a year and a Secretariat which is located in Kingston, Jamaica.

The IBA provides members with an opportunity to discuss common problems and evolve co-operative policies to facilitate further development of their bauxite/alumina/aluminium industries. To date the Association's work has been mostly concerned with exchanging views and information on a range of industry matters. The commercial and technical aspects of formulating minimum export prices for bauxite and alumina has received particular attention. In December 1979 the Council adopted recommendations on minimum CIF prices for bauxite and alumina sold by member countries in 1980. Australia was not included in the majority that voted for the recommendations and is not bound by them. The Association publishes a Quarterly Review and a bi-monthly newsletter.

MINERAL INDUSTRY STATISTICS

Statistics in the following pages refer mainly to the mining industry, mineral production, mineral exploration, mineral processing and treatment, and overseas trade.

Mining industry statistics

This section contains statistics of the mining industry in Australia obtained from the annual census of mining establishments. The annual mining census is conducted throughout Australia on an integrated basis with other economic censuses, e.g. the annual census of manufacturing establishments, electricity and gas establishments and the periodic censuses of retail and wholesale trade establishments.

Statistics are also available for *enterprises* engaged in the mining industry. The latest statistics for mining are in respect of 1977-78 and were published in *Enterprise Statistics: Details by Industry Class, Australia,* 1977-78 (8103.0). Enterprise statistics for mining are now produced annually and should be available within two years of the end of the financial year to which they relate.

The following table shows key items of data for establishments in Australia for 1978-79 based on the 1978 edition of the Australian Standard Industrial Classification (ASIC). The 1978 edition of the classification replaces the 1969 preliminary edition which has been in use since the 1968-69 census. A document fully describing the differences between the 1969 and 1978 editions of the ASIC is available on request.

Industry	y									Total pur- chases,		Rent	Fixed capital
1978		Establish- ments	- Average employment s over whole year(a)		Wages and	Stocks			transfers in and		and leasing	expendi- ture	
ASIC code	Description	at 30 June	Males	Females	Persons	salaries (b)	Turnover	Opening	Closing	selected expenses	Value added	expenses (c)	less disposals
		No.	No.	No.	No.	\$'000	\$'000	\$'000	\$'000	\$'000	\$1000	\$7000	\$'000
	Metallic minerals-												
1111	Ferrous metal ores-	71	6 607	911	7 609	125 207	1 000 301	105 565	00 070	436 019	566 670	1076	360.063
1117	Iron ore pelletising	. 23	1 254	64	1 318	21 849	203 737	27 100	20,627	420,018	11657	5,035	259,903
1112	Non-ferrous metal ores-	- *	1,254		1,510	21,049	203,737	27,700	20,007	103,407	11,057	751	2,421
1121	Bauxite	. 5	1,621	179	1,800	25,905	203,545	15,692	13,116	49,156	151.813	956	47,166
1122	Copper ores	. 15	3,892	246	4,138	59,263	251,348	18,288	31,120	76,576	187,604	349	9,773
1123	Gold ores	. 32	1,377	64	1,441	19,713	118,619	11,931	14,029	31,850	88,867	91	13,352
1124	Mineral sands	. 17	1,877	129	2,006	26,722	131,826	36,313	32,692	59,475	68,731	1,943	4,158
1125	Nickel ores	. 6	2,158	201	2,359	34,419	138,029	12,039	16,316	63,260	79,046	1,159	29,684
1126	Silver-lead-zinc ores	. 11	6,457	316	6,773	108,888	556,054	72,662	72,215	104,910	450,698	694	60,355
1127	Tin ores	. 50	1,510	111	1,621	19,616	125,551	7,490	8,413	36,831	89,643	1,477	10,546
1128	Uranium ores	. 17											
1129	Non-ferrous metal ore n.e.c.	-s . 14.	1,748	223	1,971	30,114	163,653	28,885	23,923	49,648	109,044	741	40,942
11	Total metallic minerals	. 178	28,591	2,344	30,935	471,695	2,900.645	335,964	321,162	1,083,210	1.802,632	11,179	478,359
	Coal, oil and gas-												
1201	Black coal	. 119	24,185	519	24,704	457,267	2,002,317	201,089	226,240	647,906	1,379,563	12,334	401,297
1202	Brown coal	. 47	1 2 245	105	1 150	57.015	1 074 042	A7 69A	42.066	106 471	066 057	816	118 221
1300	Oil and gas	. 11,1	<i>د</i> ډير م	105	3,330	57,015	1,074,042	42,004	42,000	100,471	300,333	610	110,201
	Construction materials-												
1401	Sand and gravel	. 308	1,356	115	1,471	17,276	114,475	6,633	6,814	52,917	61,739	3,965	3,861
1404	Construction material	s											
	n.e.c	. 416	4,061	365	4,426	55,363	274,513	25,625	28,269	128,651	148,506	9,050	22,473
14	Total constructio	п											
	materials	. 724	5,417	480	5,897	72,639	388,988	32,259	35,084	181,568	210,245	13,015	26,334
	Other non-metalli	c											
	minerals-												
1501	Limestone	. 50	717	16	733	8,578	41,546	2,490	3,100	18,118	24,037	822	7,856
1502	Clays	. 125	273	19	292	2,841	21,484	2,750	3,108	12,480	9,362	467	1,306
1504	Salt	. 23	646	63	/09	10,860	39,089	10,138	9,466	13,471	24,946	123	7,116
1505	Non-metallic mineral	15		00		12.000	70 150	16 260		10 (14	77 747	2 404	0 600
15	B.C.C.	. 134	1,083	89	1,1/2	13,938	19,358	10,309	13,982	30,034	1,941	3,401	8,083
12	i un uner non-metalli	223	3 7 10	107	2 004	26 720	191 474	20 7 20	20 6 5 5	04 702	85 601	5 414	24.041
	manerais	. 532	2./19	18/	2,900	30,238	101,4/0	30,738	29,033	94,/UJ	03,091	5,414	29,701
	Total mining	1 1 1 1 4 9	64 147	3 670	67 707	1 004 844	6 847 449	647 773	645 204	2 113 847	4 445 094	42 754	1 649 197
	(exen services to mining	, 1,500		3,033	01,194	1,0,4,033	0,047,400						

MINING ESTABLISHMENTS: SUMMARY OF OPERATIONS BY INDUSTRY CLASS, 1978-79

(a) Includes working proprietors. (b) Excludes amounts drawn by working proprietors. (c) Included in "Total purchases, etc." and in the calculation of "Value added".

Mining accidents

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. A table setting out mining accidents by States is shown below.

MINING ACCIDENTS(a)										
	Metal mining		Fuel mining		Construct material quarrying	tion g(b)	Non-meta {excludin mining	ıl g fuel) 	Total min and quari	ing ying
	Number o casualties	Number of casualties		оў 5	Number o casualties	9 5	Number of casualties		Number of casualties	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
1978-79										
New South Wales	4	175	14	69	-	10	2	13	20	267
Victoria	-	-	-	38	-	31	-	1	-	70
Queensland	(<i>d</i>)1	(<i>d</i>)123	(<i>d</i>)1	(d)376	-	(d)13	-	(d)5	.(d)2	(d)517
South Australia	1	38	-	29	1	9	2	17	4	93
Western Australia	4	250	-	64	1	13	-	10	5	337
Tasmania	3	248	1	17	-	2	-	2	4	269
Northern Territory	-	24	-	-	-	-	+	-	-	24
Australian Capital Territory .	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Australia(b)(c)	13	858	16	593	2	78	4	48	35	1,577
1977-78	10	1,014	7	450	6	88	5	55	28	1,607

(a) See text regarding comparability between States. (b) Mining accident data for construction material quarrying in the A.C.T. are not available. (c) These figures include some accidents in the mineral processing industry, and, in Western Australia, in electricity generating plants at the mine site. (d) Year ended 31 December 1979.

Mineral production

This section contains details of the output (quantity and value) of minerals produced and the metallic content of ores, concentrates, etc.

The statistics shown have been derived from data collected in the annual mining census and in returns to the various State Mines Departments, supplemented in some cases by information made available by the Department of National Development and Energy and from other sources.

For details of the scope of mineral production statistics and their relation to mining industry statistics, and the principles for measuring the output of minerals, see Year Book No. 61 and earlier issues.

Ouantity of minerals produced

The following tables show particulars of the quantities of minerals produced during 1978-79 and earlier years, together with details of the aggregate quantity of each metal, metallic oxide or elements contained in the various metallic minerals produced.

OUANTITY OF MINERALS PRODUCED AND METALLIC CONTENTS OF ORES, CONCENTRATES,

ET	C.
_ L, I	. .

Mineral	1976-1	77 1977-78	1978-79								
METALLIC MINERALS											
Antimony concentrate	onnes n	.p. n.p.	1,518								
Antimony content	" n	p. n.p.	n.p.								
Antimony ore	onnes 1,2	30 464	3								
Antimony content	., 1	11 61	2								
Bauxite	onnes 22,8	06 24,642	25,541								
Alumina (A1.O.) content	., n	.p. n.p.	n.p.								
Beryllium ore the second secon	onnes		_								
Beryllium oxide (BeO) content	tu(a)	-									
Bismuth concentrate	onnes 5,3	38 5,743	n.p.								
Bismuth content	onnes 8	53 756	n.p.								
Copper content	onnes 1.1	16 1.227	831								
Gold content	kg 4	85 533	140								

For footnotes see end of table.

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QUANTITY OF MINERALS PRODUCED AND METALLIC CONTENTS OF ORES, COCENTRATES, ETC-continued

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Selenium content . . tonnes 28 31 Silver content .	122
Silver content . . . kg 191 210 Copper concentrate .	122
Copper concentrate	
Copper content	819
	216,714
Bismuth content	n.p.
Gold content	1,717
Lead content	1,625
Silver content	32,976
Zinc content tonnes 1,210 1,259	2,680
Copper ore	2,433
Copper content	174
Gold content kg 1 —	_
Silver content	24
Copper ore for fertilizer tonnes	-
Copper content	_
Copper oxide	3,403
Copper content	2,632
Copper precipitate tonnes 45 51	21
Copper content	16
Gold bullion(b)	18,765
Gold content	15,902
Silver content	1,577
Gold ore	197
Gold content kg 2 1	1
Iron ore(c)	84,595
Iron content	53,248
Iron oxide(d)	47,711
Lead concentrate	658
Lead content tonnes 391,286 385,510	394,913
Antimony content	570
Cadmium content	101
Copper content	5,211
Gold content	345
Silver content	692,355
Sulphur content tonnes 48,536 49,576	57,314
Zinc content	38,777
Lead-copper concentrate tonnes 25,709 46,654	24,719
Lead content	5,155
Copper content	3,343
Gold content	1,038
Silver content	49,995
Sulphur content tonnes 7.674 11.478	7,558
Zinc content	2,546
Lead ore (e) tonnes 34.760 51.066	5,367
Lead content	726
Silver content kg 2,175 3,234	1.778
Lead-zinc middlings tonnes 21.656 628	
Lead content 1992 208	_
Antimony content	
Cadmium content	
Connect content 250 8	
Gold content kg 58 2	
Silver content 21 764 200	
Subsection Subsect toppes 6172 179	
Zinc content 9324 188	_
Metallurgical grade - '000 tonnes 1.681 1.325	1 385
Manganese content 806 672	656
Mineral Sands (A	0.50
	1 207
$\begin{array}{cccc} minimum concentrate (g) & \dots & $	682 144
International contents 020,002	10
Tituium divide content	16 972
	10,073
	17 295
	17,383

For footnotes see end of table.

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Mineral 1976-77 1977-78 1978-79 '000 tonnes 371 274 269 Rutile concentrate . . Titanium dioxide content 354,966 262,990 258,471 tonnes . . . '000 tonnes Xenotime concentrate Yttrium oxide content 3,900 4,848 6,060 kg Zircon concentrate '000 tonnes 408 365 454 . 284,956 176,975 Zirconium dioxide content tonnes 325,542 Nickel concentrate '000 tonnes 450 467 353 54,578 56,850 43.944 Nickel content . . . tonnes Cobalt content 171 234 145 ,, Copper content 4,438 4,839 3,474 ,, Palladium content kg 213 356 175 Platinum content 81 141 69 ,, 2,586 '000 tonnes Nickel ore 2,238 2,560 . . . 26,521 30,141 36,441 Nickel content tonnes . '000 tonnes 111 Pyrite concentrate 228 252 Sulphur content tonnes 109,807 114,690 52,986 Tantalite-columbite concentrate 105 207 107 tonnes . . 41,050 89,040 Tantalite-columbite content kg 63,771 Tin concentrates 20,944 22,684 22,618 tonnes 11,964 10.253 11,726 Tin content Tin-copper concentrate tonnes 2,610 1,806 1,980 72 45 47 Tin content . •• Copper content 535 390 457 •• Tungsten concentrates-3,190 3.129 Scheelite concentrate tonnes n.p. Tungstic oxide content 228,539 mtu(a) n.p. n.p. 1,840 Wolfram concentrate 567 . . tonnes n.p. Tungstic oxide content mtu(a) 39,735 127,232 . . . n.p. Zinc concentrate '000 tonnes 822 850 879 Zinc content . . . tonnes 426,194 441.888 453.260 Cadmium content 1,441 1,472 1,559 •• Cobalt content 109 108 86 . •• 1,587 Copper content 1,226 1,228 •• Gold content 297 kg 215 227 Lead content tonnes 16,446 16,943 18,647 Manganese content 5,241 5,534 5,856 Mercury content . . . kg 21 Silver content . . . 53,199 59,512 65,532 kg Sulphur content 269,214 280,758 261,861 . . . tonnes . . Zinc ore 4,643 4,137 tonnes 1.764 1.874 COAL Black coal '000 tonnes 75,982 79,338 81,197 Bituminous 70,467 73.654 75.332 ,, Sub-bituminous 5,516 5,684 5,865 ,, Brown coal (lignite)(h) 28,231 27,644 29,095 •• Brown coal briquettes 1,035 1.064 1,131 . . OIL AND GAS (i) '000 cu m 24,549 24.941 Crude oil 24.839 Natural gas mil. cu m 6,093 6,720 7,686 Natural gas condensate(j) '000 cu m 6 6 13 . . . 103,350 110,455 144,025 Ethane •• Liquefied petroleum gases (k)-1,544 Propane 1,208 1,269 ,, 1,325 1,388 1,683 Butane ••

QUANTITY OF MINERALS PRODUCED AND METALLIC CONTENTS OF ORES, COCENTRATES, ETC—continued

For footnotes see end of table.

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QUANTITY	OF	MINERALS	PRODUCED	AND	METALLIC	CONTENTS	OF	ORES,	COCENTRATES,
				ETC-	-continued				

Mineral		1976-77	1977~78	1978-79
CONSTRUCTIO	N MATERIALS	(/)		
Sand	'000 tonnes	24,950	24,345	23,855
Gravel	"	15,071	14,394	13,958
Dimension stone	**	87	91	147
Crushed and broken stone	••	53,012	60,576	54,223
Other	**	30,222	26,905	32,899
OTHER NON-ME	TALLIC MINER	RALS		
Asbestos	tonnes	55,814	50,590	67,514
Barite	"	n.p.	11,035	n.p.
Carbon dioxide				
Chlorite	tonnes	-	_	
Clays-				
Brick and shale	'000 tonnes	8,571	8,549	8,028
Other(m)	**	1,190	n.p.	1,162
Diatomite	tonnes	1,371	2,630	2,815
Dolomite	17	535,330	622,939	684,278
Felspar (including cornish stone)	**	2,998	2,505	3,506
Garnet concentrate	19	658	1,187	1,333
Gypsum	'000 tonnes	992	900	1,074
Limestone (including shell and coral)	۰,	10,528	10,750	10,813
Magnesite, crude	tonnes	16,873	18,138	26,560
Mineral pigments-red ochre	17	166	193	737
Peat(n)	17	n.p.	n.p.	n.p.
Pebbles-for grinding	••	1,260	1,673	1,473
Perlite	**	4,621	829	1,971
Phosphate rock	"	455,986	397,041	6,986
Pyrophyllite	"	12,112	12,774	13,318
Salt	'000 tonnes	5,023	5,410	5,339
Silica	**	1,406	1,314	1,618
Sillimanite	tonnes	7,228	589	545
Tale (including steatite)	'000 tonnes	86	123	142

(a) Metric ton unit (mtu) equals 10 kilograms. (b) Includes alluvial gold. (c) Includes iron concentrate. (d) For cement manufacture, coal washing. (e) Includes silver-lead ore, silver-lead slimes and lead slag. (f) Details relating to rutile-zircon concentrates produced in one State and finally separated in another State are included in separate form in the data of the State of origin. (g) Includes Beneficiated limenite. Also includes ilmenite from which titanium dioxide is not commercially extractable. (h) Excludes brown coal used for briquette production. (i) Source: Department of National Development and Energy and State Mines Departments. (j) Salesexcludes condensate blended and other petroleum products. (k) Excludes refinery production. (l) Incomplete. (m) Incomplete owing to difficulties of coverage. (n) Comprises peat for fertiliser and peat moss.

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CONTENTS OF METALLIC MINERALS PRODUCED

Contents of metallic minerals produced	1976-77	1977-78	1978-79
Alumina (Al ₂ O ₃)	n.p.	n.p.	n.p.
Antimony tonnes	n.p.	n.p.	1,588
Beryllium oxide (BeO) mtu(a)		<u> </u>	_
Bismuth	1,056,199	890,703	n.p.
Cadmium tonnes	1,548	1,545	1,660
Cobalt	2,210	2,646	3,451
Copper	217,216	217,083	238,688
Gold	15,666	21,047	19,584
Iron(b)	60,164	54,739	53,248
Lead tonnes	418,226	418,801	423,492
Manganese	811,414	633,047	662,326
Mercury	21	_	· _
Monazite tonnes	6,487	8,646	17,385
Nickel	81,099	86,991	80,385
Palladium	213	356	175
Platinum	81	141	69
Selenium tonnes	28	31	
Silver	840,084	837,315	874,075
Sulphur tonnes	434,050	445,137	398,616
Tantalite-columbite $(Ta_2O_3 + Nb_2O_3)$	41,050	89,040	63,771
Tin tonnes	10,325	11,771	12,011
Titanium dioxide (TiO ₂)	903,756	905,936	958,499
Tungstic oxide $(WO_1)^2$	n.p.	n.p.	355,771
Yttrium oxide (Y ₂ O ₂)	3,900	4,848	6,060
Zinc tonnes	475,306	484,376	498,484
Zirconium dioxide (ZrO ₂)	325,572	284,956	176,975

(a) Metric ton unit (mtu) equals 10 kilograms. (b) Excludes iron content of iron oxide not intended for metal extraction. Includes iron contained in iron concentrate.

Value of minerals produced

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

VALUE OF MINERALS PRODUCED

(\$'000)

Mineral	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
	MET	ALLIC MINE	RALS			
Antimony						
Concentrate	932	1,904	1,462	n.p.	n.p.	1,409
Ore	n.p.	n.p.	n.p.	n.p.	n.p.	2
Bauxite	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Beryllium ore	23	· 1	<u> </u>		<u> </u>	_
Bismuth concentrate	7.609	14.085	10,591	12.183	7,923	n.p.
Copper-		,	,	,	,	•
Concentrate	267,873	168.047	159.876	182.448	151.487	256,469
Ore(a)	n.p.	766	305	1.202	109	200
Ore for fertiliser	5	3	_		_	
Oxide	982	1.406	1.900	2.730	3.656	4,409
Precipitate	168	31	42	31	27	14
Gold-						
Bullion(b)	26.839	43,139	43.735	47.501	82,122	101.592
Concentrate	n a.			219	215	746
Ore	3	8	10		3	9
Iron ore	427.518	613,169	674.515	746.577	769.408	801.636
Iron oxide	n D.	855	915	1,000	1 020	932
Lead concentrate	110 875	124 519	117.099	177 760	208 343	339 400
Lead-copper concentrate	8 799	7 609	8 363	10 822	15 745	16 531
Lead ore(d)	403	579	566	527	964	10,551
Lead-zinc middlings	2 002	2 4 2 2	2 094	5 630	110	
Manganese ore	2,002	2,422 n n	2,074	5,050		60 563
Mineral sands_	n.p.	n.p.	p.	.u.p.	n.p.	00,000
Ilmenite concentrate(e)	7 953	14 270	15 835	17 753	21 860	23 769
	1,955	2 079	2,035	1 219	21,000	23,700
Leacovene concentrate	1,000	2,079	2,078	1,518	2,205	2,497

For footnotes see end of table

Mineral	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
Monazite concentrate	542	515	774	1.178	1.621	4.205
Rutile concentrate	36,750	53.674	71 750	75 654	50.631	51,267
Xenotime concentrate	7	12	9	9	15	. 19
Zircon concentrate	16,726	58,128	60.935	42.026	25,729	27,189
Nickel concentrate	п.р.	· n.p.	n.p.	n.o.	n.p.	n.p.
Nickelore	n.p.		n.p.	n.p.	n.p.	n.p.
Pyrite concentrate	238	441	771	709	833	710
Tantalite-columbite concentrate	777	942	1 256	1 127	3,670	5 202
Tin concentrate	43 448	49 138	49,060	70.022	108 927	135 365
Tin-conper concentrate	860	390	435	383	287	332
Tungsten ores and concentrates	5,292	11.385	15 497	34 204	0.0	43,253
Liranium concentrate	n a		2 641	15 460	24 077	47 832
Zinc concentrate	97.122	138.385	133 340	132 922	120 217	1 38 464
Zincore	1.551	2 4 3 9	1 600	325	362	
Other metallic minerals		84	2,928	n.p.	n.p.	n.p.
Total metallic minerals .	1,281,782	1.572,746	1.676,273	1,986,680	2,059,716	2,407,524
		COAL				
Black coal	449,855	874,879	1,211,199	1,438,289	1,576,914	1,670,553
Brown coal (lignite) (f)	27,251	40,556	48,346	55,905	64,925	79,630
Brown coal briquettes	11,011	11,391	11,974	14,925	16,536	25,063
Total coal	488,116	926,827	1,271,519	1,509,119	1,658,375	1,775,246
	0	IL AND GAS	S(g)			
Oil and Gas	378,750	446,298	488,419	534,815	671,233	919,793
· · · · · · · · · · · · · · · ·	CONSTRU	ICTION MAT	TERIALS(h)			
Construction materials	196,611	238,044	256,328	272,774	308,174	353,062
	OTHER NO	N-METALLI	C MINERAL	s		
Asbestos	4,140	7,960	18,406	20,382	20,514	21,149
Barite	98	303	п.р.	n.p.	404	n.p.
Carbon dioxide	52	45	56	163	180	208
Chlorite	n.a.	10,084	8,723			
Clay-			,			
Brick clay and shale	11,153	10,241	12,634	12,821	13,676	15,513
Other clays	n.p.	n.p.	4,335	4,774	7,085	8,059
Diatomite	70	45	60	71	310	380
Dolomite	1.087	991	1.262	1.421	1.654	2,107
Felspar (including cornish stone)	48	87	97	77	63	89
Garnet concentrate	2	-		11	21	45
Gems	47.262	37.032	41.972	64.006	70.219	67.292
Gypsum	3.665	3,176	3.069	4.216	4.061	4.844
Limestone (including shell and	5,005	5,110	5,007	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	.,	
coral)	20.794	24.221	26.087	30.154	34.159	39,193
Magnesite, crude	291	722	n.p.	340	411	1,503
Mineral pigments-red ochre	6		15	3	4	11
Peat(i)	143	146	n.p.	n.p.	n.p.	n.p.
Pebbles—for grinding	43	27	38	35	27	53
Perlite	ii	32	12	45	17	15
Phosphate rock	6	894	1.508	4.477	1.672	44
Pyrophyllite	103	156	200	187	229	345
Salt	16.410	21,951	29.394	33,623	38,558	38.091
Silica	5.353	6.301	6.559	n.p.	n.p.	11.531
Sillimanite	19	22	18	141	27	31
Talc (including steatite)	1.363	1.348	n.p.	n.p.	n.p.	n.p.
Vermiculite	п.р.	n.p.		n.p.	7	- 2
Total other non-metallic						
minerals	116.062	1 20,097	149,398	188,057	205,143	215,316

For footnotes see end of table

VALUE OF MINERALS PRODUCED-continued

Mineral	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
		TOTAL	•			
Total, all minerals and construc- tion materials	2,461,320	3,304,012	3,841,444	4,491,445	4,902,640	5,670,941

(a) Includes value of copper slag. (b) Includes alluvial gold. (c) Excludes value of Western Australian production. (d) Includes value of silver-lead ore, silver-lead slimes and lead slag. (e) Includes beneficiated ilmenite. (f) Excludes value of coal used in making briquettes. (g) The values shown are estimates based on prices prescribed in legislation quoted market prices and information from government departments. Includes values for crude oil autural gas, natural gas condensate, ethane, propane and butane. (h) Incomplete owing to difficulties of coverage in some States. (i) Comprises peat for fertilizer and peat moss.

Foreign participation of the mining industry in Australia

Summary information on foreign participation in the mining industry in Australia is shown in Chapter 24, Overseas Transactions. More detailed statistics are available in *Foreign Ownership and Control of the Mining Industry* (5317.0) and *Foreign Control in Mineral Exploration* (5323.0).

Mineral exploration (other than for petroleum)

Definition

Exploration 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 carried out primarily for the purpose of commencing or extending mining or quarrying operations (including the construction of drives, shafts, winzes, etc. in underground mines, and the preparation of quarrying sites, including overburden removal, for open-cut extraction).

Sources of statistics

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

Classification

The data obtained in the mineral exploration census are divided into the following categories:

(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 the production of minerals.

(b) Other private exploration—relates to exploration carried out by private enterprises on areas covered by exploration licences, authorities to enter, authorities to prospect and similar licences and authorities issued by State Governments for exploration of minerals. Also included is exploration by private enterprises which is not directly connected with areas under lease, licence, etc.

(c) Exploration by government—relates to exploration of minerals carried out by Federal and State Government Departments, local government authorities and business undertakings operated by those departments or authorities.

Expenditure, metres drilled

The following table shows expenditure and metres drilled on mineral exploration other than for petroleum in Australia during the last six years.

	1973–74	1974-75	1975-76	1976-77	1977–78	1978-79
Expenditure (\$'000)						
On drilling	28,824	36,172	35,104	40,888	56,277	57,688
Other	83,714	88,029	82,033	108,605	120,058	143,421
Australia	112,539	124,200	117,137	149,493	176,336	201,109
Metres drilled ('000)-						
Drilled-core	657	733	530	529	638	642
Drilled-non-core	1,854	1,775	1,589	1,434	1,893	1,871
Australia	2,511	2,509	2,119	1,963	2,531	2,513

MINERAL EXPLORATION (OTHER THAN FOR PETROLEUM)

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Petroleum exploration

Source of statistics

These statistics were collected and compiled by the Bureau of Mineral Resources, Geology and Geophysics, Canberra. Statistical and other information relating to petroleum exploration is published by the Bureau of Mineral Resources in *The Petroleum Newsletter* (issued quarterly) and *The Australian Mineral Industry Annual Review*, and by the Australian Bureau of Statistics in its quarterly publication *Petroleum Exploration*, *Australia* (8409.0).

Scope

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

Operations

The following table shows particulars of expenditure, and wells and metres drilled in petroleum exploration in recent years.

		1976	1977	1978
Expenditure				
Private sources	\$'000	49,125	84,970	111,564
Government sources	\$'000	5,131	4,704	4,915
Total	\$'000	54,256	89,674	116,479
Wells-				
Drilled (i.e. those which reached final depth)-				
As oil producers	No.		2	7
As gas producers	No.	6	2	3
As oil and gas producers	No.	_	. —	_
Plugged and abandoned	No.	11	17	43
Total	No.	17	21	53
Average final depth of wells drilled	m	2.342	2,577	1,973
Drilling still in progress at 31 December (uncompleted holes)	No.	3	3	3
Wells drilled or drilling over 3,000 metres	No.	4	10	10
Metres drilled-				
Completed wells	m	40,198	49,307	104,583
Uncompleted holes	m	7,314	10,176	5,026
Total	m	47,512	59,483	109,609

PETROLEUM EXPLORATION

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

Mineral processing and treatment

The extraction of minerals from ore deposits, as in mining and quarrying, is only a part of mineral technology, as few minerals can be directly used in the form in which they are mined. In most cases minerals must undergo considerable processing and treatment before utilisation. The sectors of the economy which carry out this work are classified for statistical purposes to Manufacturing Industry (see Chapter 17, Manufacturing and Internal Trade).

Principal products

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

Commodity	1976–77(a)	1977–78(a)	1978–79(a)
METALS(b))		
Non-ferrous—			
Alumina	tonnes 6,485	6,694	6,921
Refined aluminium	ionnes 236,943	259,592	264,798
Blister copper(c)	. 164.041	167,947	170,458
Refined copper	. 157.452	155,353	137,863
Lead bullion (for export)(c)	. 158.656	155,641	162,185
Refined lead		207,939	217,992
Refined zinc	. 261.914	262.615	308.622
Refined tin	5.373	5.994	4.857
Ferrous-	,,	- • • •	,
Pig iron(d)	tonnes 6.958	7.096	7.345
Steel ingots(d)	7.473	7.532	7,541
Precious-	" ,,,,,,	.,	.,.
Refined gold(e)	kg 11.127	17.869	15,563
Refined silver	253.268	259.217	302.032
FUELS			
Coal products-			
Metallurgical coke	tonnes 4.501	4.310	4.620
Brown coal briquettes		1.064	1.131
Petroleum products	,,	-,	-,
Motor spirit	litres 13.056	14.073	14.018
Furnace fuel	tonnes 4.604	4.138	4,343
Automotive distillate	5.249	5.613	5,845
Industrial diesel fuel	1.242	1,291	1,123
BUILDING MATH			
Clay bricks m	villions 2.033	1 911	1 914
Portland cement '000	tonnes 5.083	5.016	5 085
Plaster of paris	38/	3/8	347
Plaster cheets '00		48 034	48 509
CHEMICAL	S		
Sulphuric acid	tonnes 1.752	1.837	1,940
Caustic soda	tonnes 134.247	130.830	n.p.
Superphosphate(f) '000	tonnes 3.180	3,430	3,680
	5,100	5,150	

(a) Some products exclude production of single establishment manufacturing establishments employing less than four persons and production of establishments predominantly engaged in non-manufacturing activities but which may carry on in a minor way, some manufacturing. (b) Excludes secondary metal with the exception of pig iron and steel ingots. (c) Metallic content. (d) Year ended 31 May. (e) Newly-won gold of Australian origin. (f) Includes double and triple superphosphate and ammonium phosphate expressed in terms of single superphosphate, i.e. $22\% P_2O_5$ equivalent.

Overseas trade

Exports and imports

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

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		Quantity		Value f.o.b. (\$'000)				
Commodity(a)		1977-78	1978–79	1979-80p	1977-78	1978-79	1979-80p	
		ЕΣ	(PORTS(b)					
Non-ferrous-								
Copper-								
Concentrate	. tonnes	109,157	131,661	157,481	31,996	43,845	88,560	
Blister	. "	7,542	12,094	24,664	14,938	26,244	48,907	
Refined	. "	62,671	53,677	47,953	67,157	76,816	93,821	
Matte, slags, etc.	. "	11,683	4,472	9,003	5,088	2,560	11,966	
Lead—								
Concentrate	· "	140,572	71,996	60,845	41,988	31,682	56,874	
Bullion	• "	157,915	159,637	183,727	116,897	150,618	370,531	
Refined	· "	138,595	152,240	162,832	71,593	101,400	167,644	
Slags and residues .	• "	2,589	18,560	12,354	846	2,459	6,863	
Zinc—								
Concentrate	• "	389,247	453,118	460,180	44,751	57,127	77,443	
Refined	·	184,290	193,826	173,761	96,066	110,963	115,844	
Slags and residues .	• "	5,446	6,441	11,872	1,404	1,072	1,566	
Tin-								
Concentrate	• "	14,682	14,244	13,963	49,841	/4,6/8	90,201	
Renned	•	2, 18 /	1,288	1,991	21,315	14,6/4	28,101	
Aluminium	2000 4 4 4 4 4 4	()(0	6 400	7 226	((7 (0)	719 030	070 076	
Alumina	. 000 tonnes	0,308	0,408	7,230	60 7,000	/18,939	9/0,805	
Formuland allow	. connes	75,921	81,020	55,049	09,270	62,219	08,448	
Ferrous and anoy—								
Pellets	'000 toppes	8 548	8 1 20	5 707	175 747	165 200	123 827	
Fines	. 000 tonnes	34 000	38 851	41 696	367 080	301 297	123,827	
	• • • •	31 143	32 565	31 385	409 087	411 021	460 361	
Tungsten-	•	51,145	52,505	51,505	407,007	411,021	400,001	
Scheelite concentrate	tonnes	3 341	3 853	3 547	33 81 3	38 448	31 970	
Wolfram concentrate		767	1 578	1 850	6 861	12 101	21 481	
Pig iron	,,	519176	784 415	618 818	39 58 3	70 546	76 208	
Steel ingots blooms		1 084 249	1 241 224	653 918	137 906	193,911	138 164	
Mineral sands-		1,00 1,2 19	.,,				,	
Ilmenite concentrate	. '000 tonnes	1.039	977	1,138	22,503	22.421	23,232	
Rutile concentrate		315	336	345	62.031	63.499	87,780	
Zircon concentrate		366	423	490	30,706	29,920	33.638	
Precious-								
Gold, refined	. kg	8,194	13,900	5,507	40,998	22,329	94,105	
Silver, refined		103,411	89,074	75,276	14,262	16,767	50,888	
Coal, black	. '000 tonnes	37,161	38,888	42,565	1,457,178	1,519,198	1,678,071	
Crude oil(c)	. '000 cu m	210	(d)370	(d)127	16,125	40,475	18,818	
<u> </u>			MPORTS					
Tin, refined	. tonnes	215	204	38	1,959	2,701	572	
Nickel (pigs, anodes, etc.)	**	2,008	1,532	600	8,154	5,905	3,228	
Ferro-alloys	• **	20,048	26,300	55,146	11,378	15,451	39,799	
Gold—				•				
Unrefined bullion(e)	. kg	1,241	512	780	5,537	2,737	10,571	
Refined	. "	228	40	27	796	267	441	
Crude oil(c)	. '000 cu m	11,261	10,293	11,240	799,135	762,843	1,404,266	
Asbestos	. tonnes	58,265	29,443	23,490	25,978	13,038	11,874	
Diamonds—	_							
Industrial	. metric						0.0.0	
	carats	833,964	1,187,540	1,096,450	4,263	6,501	8,243	
Gemstone	• • • • •	132,815	63,337	61,121	31,202	31,375	45,198	
r nosphate rock	. 000 tonnes	1,510	2,380	2,181	55,279	83,266	80,324	
Fotassium iertilisers .	. tonnes	15/,39/	108,52/	215,540	9,137	7,839	10,480	
Sulphur	•	475,708	424,000	597,128	14,442	15,077	30,832	

EXPORTS AND IMPORTS OF PRINCIPAL MINERALS AND MINERAL PRODUCTS

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

Considerable quantities of metallic ores, concentrates, slags, and residues are exported from Australia for refining overseas. The following table shows selected items exported during 1979 and their principal metallic content as estimated by assay.

PRINCIPAL METALLIC CONTENTS OF SELECTED ORES AND CONCENTRATES ETC. EXPORTED FROM AUSTRALIA, 1979

	Metallic c	ontents-esti	imated from a	assay				
Ores and concentrates, etc.	Copper	Lead	Zinc	· Tin	Iron	Tungstic Oxides	Gold	Silver
					000			
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	kg	kg
Copper concentrate	41,824	656	544	-	_	-	228	3,156
Blister copper	27,998	_		_	_	÷ '	1,823	4,388
Copper matte, slags, etc.(a)	4,369	6,078		·	_	_	152	13,157
Lead concentrate	2,931	25,146	3,214	_	_	_	588	36,976
Lead bullion	_	162,235	_	_	_	<u> </u>	294	354,556
Lead slags and residues	29	2,984		32	_	_	64	2,506
Zinc concentrate		3,983	183,801	-	_	•—		19,360
Zinc slags and residues	_		2,277		_	. —	·	
Tin concentrate	2	-	_	6,435	_			_
Iron ore-								
Pellets			_	_	5,372			· · _
Fines	_	_	_		23,606	_		_
Lump	_	-		_	20,429			_
Scheelite concentrate	_	_	<u> </u>	_	· —	2,438		_
Wolfram concentrate		-		_	<u> </u>	1,152		-
Total metallic content	77,153	201,082	189,836	6,467	49,407	3,590	3,149	434,099

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

Prices

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

AVERAGE DAILY PRICES OF SELECTED METALS AND METALLIC ORES AND CONCENTRATES: AUSTRALIAN AND OVERSEAS MARKETS(a)

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

					METAL	.S(a)				
							Gold			
	Tin						Premiu	<i>m</i>	Silver	
Period		<i>L.M.E</i> .			Aluminiu		marke (\$A-f.o	z)		U.K.
	AUSI. (\$A tonne)	(£SIg meti 10		U.S. U.S. (SUS1	kei .A. Ai 6) (\$A—ton	ust. U.S.A ne) (USc—lb)	Austral ai Overse	nd (SUS—f. as oz)	Aust. _(\$A-kg)	(Stg new pence f. oz)
1978 1979	11,666.14 14,157.08	6,701. 7,287.	50 1,476.00 52 1,960.12	2	,06 1,005 ,72 1,160	.46 50.81 .59 70.33	168.º 3 266.	97 193.39 32 307.19	153.37 300.54	282.20 519.15
Highest Lowest	15,933.00 12,193.00	8,150. 6,340.	00 2,171.00 00 1,750.00	3	.18 1,244 .00 1,074	.00 78.00 .00 55.50) 466.) 190.	80 524.00 65 · 216.55	581.72 170.61	1,446.85 296.40
	Coj	oper		Lead			Zinc			
Period	A (\$. tor	ust. A 1ne) m	L.M.E. (£Sig— etric ton)	Aust. (SA tonne)	L.M.E. (£Stg— metric ton)	U.S.A. (USc—lb)	Aust. (SA— tonne)	L.M.E. (£Stg— metric ton)	Prod. (Sig- ton)	U.S.A. (USc—lb)
1978 1979 1979	. 1,189 . 1,76	9.88 7.48	710.13 936.42	563.19 1,031.21	274.50 567.06	33.69 53.58	534.30 712.55	308.79 350.43	606.89 792.92	31.13 37.67
Highest Lowest	2,040 1,340	0.00 0.00	1,110.00 765.00	1,1 <i>5</i> 0.00 700.00	709.00 455.00	63.00 38.00	773.00 632.00	407.50 275.00	845.00 720.00	39.50 32.50

For footnotes see next page.

ORES AND CONCENTRATES												
Period								Tin Aust. (\$A-mtu)	Wolfram Europe (\$Stg-mtu)	Ilmenite Europe (\$A-metric ton)	Rutile Europe (\$A-metric ton)	Zircon Europe (\$A-metric ton)
1978 . 1979 .		•				•	:	102.26 124.60	139.08-145.45 136.83-142.16	16.58-18.83 17.00-19.00	188.33-201.66 260.00-290.00	65.00-75.00 53.75-63.75
1979 Highest Lowest	L			•		•	•	138.20 109.97	151.00 120.00	19.00 17.00	350.00 230.00	75.00 50.00

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

(a) Where a daily price does not actually exist for a commodity, daily prices have been imputed from price data which are available. NOTE: Prices data shown are those quoted in the relevant markets and are mainly derived from information collected and compiled by the Bureau of Mineral Resources. Overseas data are supplied to the Bureau of Mineral Resources by the Metal Bulletin and Metals Week.

REVIEW OF RECENT DEVELOPMENTS IN THE AUSTRALIAN MINERAL INDUSTRY (Source: Bureau of Mineral Resources, Geology and Geophysics)

Major developments in the Australian mineral industry, particularly during 1979 and the first half of 1980, are reviewed briefly in subsequent parts of this section. Additional information on developments in the industry is available in *Australian Mineral Industry Annual Review* 1978 published by the Bureau of Mineral Resources, Geology and Geophysics. That publication contains comprehensive reviews of mineral commodities of importance to the Australian economy, as well as a general review of the industry's performance during the year.

General Review of 1979

All the major economic indications of the Australian mining industry rose during 1979, indicating a general improvement in world trading conditions and an increased demand for Australian mineral commodities. Ex-mine value of output rose by 28 per cent to \$6,389 million and value added rose by 14 per cent to \$4,445 million. Quantity and value increases were recorded for black coal, base metals, iron ore, manganese ore, tin concentrate, uranium oxide, and mineral sands except for ilmenite, the quantity of which decreased slightly. Nickel production again decreased, reflecting excessive world stocks of the metal.

'Mines and Quarries' was again the largest single export earning group in 1979–80 accounting for 24.9 per cent of total exports. This figure however, excludes some exports by the smelting and refining section of the industry.

Imports—1979. The value of imports rose by 26 per cent to \$1,307 million. Crude oil remained the largest single mineral import at \$1,032 million, an increase of 31 per cent over the previous year. Other significant mineral imports were asbestos, gem diamonds, iron and steel, refined nickel, and the fertilizer requirements phosphate rock, potassium salts and elemental sulphur. Imports of mineral primary products accounted for 8.9 per cent of the total value of merchandise imports compared with 8.1 per cent in 1978.

Exports—1979. Exports rose by 19 per cent to \$5,862 million, the largest increase in several years. Most leading commodities performed strongly, an exception being zinc where markets remained weak as stocks continued to increase. Exports of zinc declined considerably. Black coal remained the largest single export earner in 1979, its value increasing by 9 per cent to \$1,612 million: it accounted for 27 per cent of the total value of mineral exports. Black coal was followed by iron ore, which increased in value by 11 per cent to \$1,008 million, and by alumina whose value increased by 15 per cent to \$783 million. These three items in 1979 accounted for 58 per cent of the total value of mineral primary products. The surplus in the balance of mineral trade increased from \$3,888 million in 1978 to \$4,555 million in 1979.

Bauxite and Alumina

In 1979, production of bauxite increased to more than 27.6 million tonnes, alumina production to 7.4 million tonnes, and aluminium to 269,575 tonnes. Australia was again the world's largest producer of bauxite and alumina.

An alumina refinery of initial rated capacity of 500,000 tonnes per year will be commissioned in 1981 at Wagerup, W.A. Capacity will be increased over 15 years to 2 million tonnes per year. Bauxite will be supplied from Willowdale, W.A. All alumina produced will be exported.

The first stage of the alumina refinery at Worsley, W.A., will be completed in 1982. Initial rated capacity is one million tonnes per year, and ultimate capacity two million tonnes per year. Bauxite will be supplied from Mount Saddleback, W.A. All alumina produced will be exported.

The production capacity of the aluminium smelter at Kurri Kurri, N.S.W., is to be increased from 68,000 tonnes to 90,000 tonnes per year by 1981. The aluminium smelter to be constructed at Gladstone, Queensland will have a first stage design capacity of 103,000 tonnes per year and will expand to 412,000 tonnes capacity by the end of the decade. The rated capacity of the other Australian aluminium smelter, at Point Henry, Victoria, supplied with Western Australian alumina, is 100,000 tonnes per year and will be expanded to 165,000 tonnes per year by early 1981.

The smelter to be built at Portland (Victoria) will have an initial capacity of 120,000 tonnes per year and be completed in 1983. Ultimate capacity will be about 500,000 tonnes per year by 1990. A second smelter to be built at Gladstone (Queensland) will also be completed in 1983 and have an initial capacity of about 100,000 tonnes per year; it will expand to 296,000 tonnes per year in the late 1980's. Two smelters will be constructed near Newcastle (New South Wales). The Tomago Smelter, to be completed in 1984, will have an initial capacity of 110,000 tonnes annually, and will be expanded to 280,000 tonnes per year in 1986. The Lochinvar Smelter, to be completed in 1984 will have an initial capacity of 236,000 tonnes per year to be expanded to 360,000 tonnes.

Copper

A summary of the copper mining industry in Australia 1953–1975 and the sufficiency of present ore reserves was published in the *Australian Mineral Industry Quarterly*, Vol. 30 No. 1.

In 1979 mine production of copper increased to 234,735 tonnes.

Drilling at Teutonic Bore, W.A., has revealed a deposit of between 2-3 million tonnes of ore containing 3.5 per cent copper, 9.5 per cent zinc, and 150g/t silver. A mine will be in production in mid-1981, producing about 300,000 tonnes of ore annually. Two substantial copper-zinc deposits have been indicated by drilling near Benambra, Victoria.

Exploration drilling is continuing at the copper-uranium-gold deposit at the Olympic Dam prospect, Roxby Downs, S.A. At Tennant Creek, N.T. the Warrego mine will be expanded and the Gecko mine developed with the emphasis on copper rather than gold as before. The smelter will be recommissioned in 1980 and will supply 15,000 tonnes of blister copper annually to Japan.

Copper production at the CSA mine at Cobar, N.S.W., is being expanded by 50 per cent and will increase ore production to more than 750,000 tonnes per year.

Iron

A summary of growth of the Australian iron ore industry 1965 to 1975 has been published in the *Australian Mineral Industry Quarterly*, Vol. 29 No. 1.

Mine production of iron ore in 1979 was 91.7 million tonnes, nearly 10 per cent higher than in 1978. Export of iron ore pellets was 78.3 million tonnes valued at \$1,008 million. Australia was the world's largest exporter of iron ore in 1979 and the second largest producer.

Silver, lead and zinc

Mine production of lead and zinc metal in 1979 was 417,485 tonnes and 531,269 tonnes respectively, both greater than the 1978 production.

A summary of the Australian lead and zinc industry from 1953 to 1973 was published in the Australian Mineral Industry Quarterly, Vol. 27 No. 4.

A decline shaft is being sunk at the Sorby Hills, W.A., lead deposit. The copper-lead-zinc mine at Que River, Tasmania, with reserves of over 3 million tonnes (7 per cent lead; 12.5 per cent zinc; 171 grams/tonnes silver; 3.4 grams/tonnes gold, 0.3 per cent copper) will commence production in 1981.

Black coal

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

The expansion of the export trade has been of major significance. In 1955 exports were about 200,000 tonnes valued at about \$1.7 million; in 1979 exports were 40.5 million tonnes valued at \$1,590 million. These increased exports have been largely to Japan and Europe, but tonnages of steaming coal greater than previously are being exported to U.S.A. and south-east Asia for use in the iron and steel industry. As a result of this increased demand, new mines have been opened and others are under

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development in Queensland and New South Wales. Exploration for coal has been stimulated and further rich deposits of coking coal and steaming coal have been located. Raw coal production in 1979 increased to 93.5 million tonnes; saleable coal output totalled 74.4 million tonnes.

A paper entitled *Coal Exploration in Australia* has been published in the *Australian Mineral Industry Quarterly*, Vol. 31, No. 1.

Petroleum

At the end of 1979, there were thirteen oil fields in production: Moonie, Alton, Conloi and Bennett in Queensland; Barrow Island, Yardarino and Dongara in Western Australia; and Barracouta, Halibut, Mackerel, Cobia, Tuna and Kingfish offshore from Victoria in Bass Strait. The production of stabilised crude oil in 1978 amounted to 25.1 million cubic metres representing 71 per cent of the year's total input to Australian refineries. In 1979, it was 25.4 million cubic metres, 70.0 per cent of that year's refinery input. The average daily production of 69,006 cubic metres in 1978 was one per cent higher than in 1977; in 1979, it was 69,589 cubic metres, 0.8 per cent higher than in 1978. Natural gas production in 1978 amounted to 7,320 million cubic metres, 11.0 per cent more than in 1977. In 1979, it was 8,381 million cubic metres, 14.5 per cent more than in 1978. About 12 per cent of this, compared with about 13 per cent in 1978 was used in the field and processing plants and the balance was sold, mainly as fuel, to markets in Victoria, South Australia, Western Australia, New South Wales and Queensland.

- Twenty-one offshore exploration wells were drilled in 1979, one fewer than in 1978; metres drilled, however, increased from 56,900 in 1978 to 76,954 in 1979. The year saw the start of exploration drilling in the deep waters of the Exmouth Plateau off northwest Western Australia. This work is being undertaken by three of the world's twelve dynamically positioned drillships. The first well in the Exmouth Plateau program was Zeewulf No. 1 in 1,188 m of water, and by the end of the year a further six wells had been drilled in water ranging from 960 m to 1,383 m deep.

Offshore development drilling continued in the Gippsland Basin on the Mackerel platform (2 wells) and Tuna platform (7 wells).

Onshore exploration drilling activity fell from 31 wells in 1978 to 30 in 1979, although metres drilled increased from 54,635 to 61,845. The drilling was mainly centred in the Bowen-Surat Basin in Queensland. Forty-seven onshore development wells were drilled, 20 more than in 1978 (Queensland 3, South Australia 4, Western Australia (Barrow Island) 40). Metres drilled for onshore development drilling fell from 54,406 to 40,961, because of the predominance of shallow wells in the Barrow Island drilling program.

During 1979 significant onshore gas discoveries were made at Warroon No. 1 and Beldene No. 1 in the Bowen-Surat Basin in Queensland, at North Paaratte No. 1 in the Otway Basin in Victoria, and in North Dullingari No. 1 and Wilpinnie No. 1 in the Cooper Basin in South Australia. Oil was discovered in Thomby Creek No. 1, about 10 km south-southwest of the Boxleigh gas field in Queensland and in North Dullingari No. 1 in the Cooper Basin.

Of the seven wells drilled in the deep waters of the Exmouth Plateau, two (Investigator and Jupiter) had minor gas shows and three (Resolution, Gandara, and Mercury) were dry. Zeewulf No. 1 found gas in two formation tests but the thin sands were considered by the operators (Esso/BHP) to be non-commercial. Scarborough No. 1 (Esso/BHP) found considerable gas reserves and is considered a gas discovery, although it is currently classed as non-commercial because the completion technology and equipment for that water depth (912 m) is not yet available. An eighth well on the plateau, Vinck No. 1, was being drilled at the end of 1979.

In the Cobia No. 2 well (Gippsland Basin) the year saw commercial oil production from Australia's first subsea completion. The subsea wellhead was installed and tied in to the Mackerel platform by a submarine pipeline. Initial production from Cobia started in July 1979. At the end of 1979 the well was producing oil at the rate of some 367 m³ (2,311 barrels)/day.

Nickel

A summary of the growth of the Australian nickel industry was published in the Australian Mineral Industry Quarterly, Vol. 28 No. 4.

Mine production of nickel in ore and concentrates was 73,323 tonnes in 1979. Australia was the fourth largest world producer. Production from the new Agnew, W. A., mine will be between 10,000 to 15,000 tonnes per year 'contained nickel' by 1984. Development of Mount Windarra continues; production will commence when market conditions become favourable. Production commenced at Agnew, W.A., in 1978. The concentrates are toll-smeltered at the Kalgoorlie smelter, the capacity of which was increased.

Mineral sands

The history of the mineral sands industry is presented in the Australian Mineral Industry Quarterly, Vol. 25 No. 1.

Considerable expansion from 43,000 to 58,000 tonnes per year has been completed in the Western Australian production capacity for the benefication of ilmenite. Australia is still the world's largest producer and exporter of ilmenite, zircon and monazite by the amalgamation of operating companies, particularly in Western Australia.

Diamonds

Diamond exploration in the Kimberley region of Western Australia has resulted in the discovery of a number of kimberlite pipes. On the basis of diamonds found, Conzinc Riotinto of Australia has set up a pilot plant to treat kimberlite at Ellendale, W.A. Another plant was established at Argyle, W.A., to bulk-test the diamond-bearing alluvials and kimberlite in the Smoke Creek area.

Uranium

Construction of a metallurgical pilot plant at Kalgoorlie, W.A., to test ore from Yeelirrie, W.A., began in 1979. The Nabarlek, N.T., ore body has been mined out and the ore stockpiled for onsite yellowcake production over the next eight years. Mine construction at the Ranger Deposit, also in the Pine Creek Geosyncline, continued in 1979 and yellowcake production is expected to commence in late 1981.

REFERENCES

Further detailed statistics and information on the subjects dealt with in this chapter are contained in the annual printed publication *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 the ABS a quarterly publication, *Australian Mineral Industry Quarterly* (8403.0). The annual ABS statistical publications, *Census of Mining Establishments, Summary of Operations, Australia (Preliminary)* (8401.0). *Census of Mining Establishments, Details of Operations, by Industry Class, Australia* (8402.0); *Mineral Production, Australia* (8405.0); *Mineral Exploration, Australia* (8407.0) and the irregular publication *Census of Mining Establishments, Industry Concentrations Statistics, Australia* (8411.0), contains economic statistics of the industry prepared and published as soon as possible after the data have been compiled. A monthly statistical publication, *Minerals and Mineral Products, Australia* (8404.0) is issued also, and other current statistics on mining or mine products are contained in the *Monthly Summary of Statistics, Australia* (1304.0), the Digest of Current Economic Statistics, Australia (1305.0), and the monthly publication *Production Statistics, Australia* (1305.0).

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