

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, south-western New South Wales and southern South Australia, and as residual basalt cappings over extensive areas of the Palaeozoic rocks of eastern Australia.

Economic geology

Minerals of economic significance occur throughout Australia, their geological age ranging from Precambrian to Recent. Many of the large deposits such as those at Broken Hill (N.S.W.), Mount Isa (Qld), the Kalgoorlie and Pilbara regions of W.A. and the Alligator Rivers area of N.T. are Precambrian in age. In eastern Australia the major deposits such as the Elura, Cobar, Woodlawn and Rosebery base-metal deposits and most of the black coal deposits, are Palaeozoic in age. The black coals of the Moreton district of Queensland, northeast New South Wales and Leigh Creek, S.A. are of Mesozoic age. Deposits formed in Tertiary times include the brown coal in Victoria, the bauxites of Weipa (Qld), Gove (N.T.) and the Darling Range (W.A.) and the nickeliferous laterites at Greenvale (Qld).

Mineral resources

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

For further details of principal Australian mineral deposits, and notes on principal mineral resources, see Year Book No. 61, pages 925-932 and the Australian Mineral Industry Quarterly and Annual Reviews.

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.

Mineral exploration and development

Onshore. 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.

As a result of the introduction of large-scale modern prospecting methods (particularly airborne prospecting), small prospecting areas 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.

Off-shore. Following the enactment of the *Seas and Submerged Lands Act 1973* the High Court confirmed that the Commonwealth has sovereignty over the territorial sea and 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 mining within the outer boundary of the 3 mile territorial sea should lie with the States, while the Commonwealth should have responsibility for areas beyond.

The Minerals (Submerged Lands) Act 1981 passed by the Commonwealth Parliament in June 1981 follows the scheme of the offshore petroleum legislation amendments passed in 1980 and provides for Joint Commonwealth/State Authorities to be responsible for major matters under the legislation with the States being responsible for day-to-day administration. The 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 mining is carried out under the States' onshore mining legislation on an interim basis.

The mining code under the new legislation provides for a two-stage system of titles: the exploration permit, which covers all forms of exploration, and the production licence, which covers development. The sharing of royalty between the State and the Commonwealth Governments is to be on a 60-40 basis for all offshore mining, including land-based underground mining.

Petroleum exploration and development

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. In the offshore constitutional settlement between the Commonwealth and the States reached in June 1979, it was agreed that, as in the case of mining for other minerals, responsibility for administering petroleum exploration and production within the outer boundary of the 3 mile territorial sea would be a State responsibility, while the Commonwealth would have responsibility for the continental shelf beyond the 3 mile territorial sea.

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 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 together with complementary State legislation in respect of the 3 mile Territorial Sea will be proclaimed to come into effect in late 1982. In the meantime administration of offshore petroleum continues to be carried out under the 1967 legislation.

The mining code applicable under the legislation provides for a two-stage system of titles: the exploration permit, which covers all forms of exploration including drilling, and the production licence, which covers development and exploration. 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.

MINERAL ROYALTY RECEIPTS: GOVERNMENTS

(\$'000)

	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
New South Wales(a)	32,660	46,354	49,062	35,651	86,797	116,923
Victoria(b)(c)	29,893	32,696	48,446	60,111	90,554	118,611
Queensland(a)	36,753	50,842	53,651	53,679	73,522	73,329
South Australia	2,788	3,346	4,106	4,541	5,869	7,312
Western Australia	43,111	51,638	54,519	57,810	66,712	78,341
Tasmania	576	1,496	2,093	2,193	5,261	3,557
Northern Territory(d)	545	362	277	1,256	2,549	5,666
Commonwealth Government(c)	13,440	13,805	23,002	28,031	43,337	54,567
Total	159,766	200,539	235,156	243,272	374,601	458,306

(a) Includes royalties on sand and gravel from Crown lands. (b) Includes royalties on brown coal paid by State Electricity Commission. (c) Includes royalties received under the *Petroleum (Submerged Lands) (Royalty) Act 1967-68*. (d) Excludes the mining royalties paid into Aboriginal Benefits trust fund prior to 1978-79.

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. Tin concentrates and refined tin are subject to quota restrictions established by the International Tin Council.

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.

Exporters of common salt in bulk and of ores, concentrates, matte and oxides of nickel, lead, zinc, copper, manganese, tungsten, and blister and refined copper and lead bullion are given automatic approval to export, on application, to cover expected shipments over a 12 month period. 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:

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

Queensland Coal Board

The Queensland Coal Board 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) as well as through the National Energy Research, Development and Demonstration Program.

Income taxation concessions. As at 30 June 1982 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.

From July 1982 mineral exploration and development enterprises have the option of using special depreciation arrangements or those which apply to industry in general.

Special deductions for capital expenditure incurred in the exploration for and development 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 ten years, whichever is less on a straight line 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 ten years, whichever is the lesser. 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 18 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 27 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 Commissioner 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.

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.

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 and importers of phosphate fertilisers. The *Phosphate Fertilisers Bounty Act 1963* provides for a subsidy to be paid on phosphatic substances produced in Australia or imported and sold for use in Australia as a fertiliser. Phosphatic substances used as a supplement to stock food are also regarded as being used as a fertiliser. Subsidy 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, subsidy 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 1985.

Payments to producers and importers of nitrogenous fertilisers. The *Nitrogenous Fertilisers Subsidy Act 1966* provides for a subsidy to be paid on nitrogenous substances produced in Australia or imported and sold for use in Australia as a fertiliser. Nitrogenous substances used as a supplement to stock food are also regarded as being used as a fertiliser. Subsidy is payable at the rate of \$20 per tonne of the nitrogen content of which the goods consist. The intention of the Act is to assist consumers of nitrogenous fertilisers (primary producers). The Act expires on 30 June 1985.

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.

At 31 August 1982, 509 officers were employed at the BMR, this included 161 professional officers (geologists, geophysicists, chemists, engineers and mineral economists) and 48 research scientists.

BMR's research program is carried out by four Divisions—Geophysics, Continental Geology, Marine Geoscience and Petroleum Geology and Petrology and Geochemistry. Mineral and petroleum resource assessments are undertaken by the Resource Assessment Division which includes Mineral and Petroleum Branches and a Uranium Resource Evaluation Unit. Other branches will handle planning and programs, special projects and geoscience services, and geoscience data.

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 primary objective of the Department of Mineral Resources is to promote the responsible development of mineral resources in New South Wales. The Department administers the various Acts (Coal, Petroleum and Mining) and grants titles to encourage and facilitate the exploration for, prospecting and development of, the State's mineral resources. The Department's staff is deployed in many diverse areas of activity to encourage and assist mining and resource development projects by the mining industry.

A wide range of services, information and advice is provided on many subjects including geological and geophysical investigations, scientific and chemical research, geological and metallogenic mapping, prospecting, mining legislation and administrative procedures. The Geological and Mining Museum, one of the States's foremost specialist museums, is maintained by the Department, as is the reference library of geology, mining and allied topics situated at the Department's head office.

The Department is engaged in the continuous assessment of the State's mineral resources; its coal exploration and assessment programme in particular has identified many coal deposits of high commercial promise.

Victoria. The Department of Minerals and Energy comprises the Divisions of Administration, Energy, Geological Survey, Hazardous Materials, Mining and Oil and Gas. The Department conducts geological, groundwater and mineral surveys, produces geological maps, and issues scientific and technical reports thereon. 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, hazardous materials, mining and extractive industry legislation ensures that mineral and petroleum exploration and production (both on-shore and off-shore), mining and quarrying are regulated and controlled. Also that the manufacture, transport, storage and use of explosives and the storage and transportation of inflammable liquids and liquefied gases 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 crushing 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. Information on the manufacture, handling and use of explosives, inflammable liquids and liquefied gases is also provided. Financial assistance is available to municipalities to reclaim mine-damaged land in areas where a reclamation committee recommends such action. The Department advises on, monitors, co-ordinates and implements energy policies.

Queensland. The Department of Mines provides assistance to mining by way of geological services, grants for construction and maintenance of roads in mining areas, repayable advances or subsidies for mine development, hiring of equipment, and assistance to prospectors. The Department maintains a concentration plant for tin ores at Irvinebank, an assay office at Cloncurry 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. The Western Australian Department of Mines operates fifteen State Batteries throughout the goldfields, for the treatment of ore (principally gold) from prospectors and small mine owners, at a nominal charge. Through its Geological Survey Division, the Mines Department carries out geological investigations and surveys throughout the State. The total expenditure in 1980-81; on activities classified as 'Mineral exploration', amounted to \$902,000. The results of this work are made available in both map and report format. The Government Chemical Laboratories Branch of the Mines Department provides analytical and research services to the mining and mineral exploration industry.

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 encourages the development of an efficient mining and processing industry. Through six divisions the Department administers relevant legislation and provides a wide range of services.

The N.T. Geological Survey Division elucidates the regional geology and geophysics of the Territory, researches new mapping, geological survey and mineral search techniques and provides technical information through its computer indexes at Darwin and Alice Springs.

Registration and orderly administration of mineral and petroleum tenure, and provision of essential drafting services fall within the ambit of the Policy and Administration Division.

Mines Division provides expertise in mining development, occupational hygiene, environment protection, and offers metallurgical services at the Tennant Creek Battery and Darwin's Metallurgical Test Centre to further its aim to encourage, control and ensure the efficient, orderly and safe recovery and utilisation of the Territory's mineral resources.

The Industrial Safety Division provides inspectorial, training and advisory safety services in the fields of construction safety, dangerous goods and machinery safety. These services are provided from the division's offices at Darwin, Alice Springs, Tennant Creek and Katherine.

Advice to Government and the industry on energy conservation, exploration and development is provided by the Energy Division whilst the Resource Economics Division provides advice to the Government on economic and policy matters of major significance to the Department and economic and project evaluation consultancies services to other divisions.

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). Operations are based in Adelaide with branch laboratories in Perth, Melbourne and Townsville. 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 Laboratory

In 1965, the Baas Becking Geobiological 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 423).

Subjects of current research are the carbon and sulphur geochemical cycles, the Proterozoic to Cambrian sedimentary basins, the devising of microbial techniques for enhancing the secondary recovery of oil and ore genesis. Geological research is coordinated with the field research programs of the Bureau of Mineral Resources, Geology and Geophysics.

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:

- Studies of sedimentary basins and of sedimentary systems, which have continental development in Australia and which may be host to fossil fuels or mineral deposits. These include studies of the characteristics and origin of fossil fuels, and studies of the effects of surface processes on the bedrock of the Australian continent.
- Studies of the structure and characteristics of the crust and upper mantle relevant to the understanding of the evolution of the Australian continent and its mineral deposits.
- Research into geophysical exploration techniques and their application.
- Carrying out of airborne radiometric and magnetic surveys and their interpretation as a basis for mineral exploration.
- Carrying out a wide range of marine geological and geophysical investigations.
- The undertaking of basic geochemical, petrological, and mineralogical studies of major sedimentary and igneous rock suites.
- Studies of metalliferous deposits and of their environments.
- Multi-disciplinary studies of metallogenic provinces.
- Assessment of Australia's mineral resources, including petroleum.
- Establishment and maintenance of the National Geoscience Data Base.

Commonwealth Scientific and Industrial Research Organization

Minerals Research

Minerals research by the Commonwealth Scientific and Industrial Research Organization (CSIRO) is undertaken within the Institute of Energy and Earth Resources. The research has the objectives of improving methods of locating, evaluating, defining and characterising Australia's mineral resources and of planning their recovery, development and effective use consistent with the minimization of environmental stresses. Divisions of the Institute engaged in mineral research are the Division of Applied Geomechanics at Syndal (Vic.); the Division of Fossil Fuels at North Ryde (N.S.W.); the Division of Mineral Chemistry at Port Melbourne (Vic.); and Division of Mineral Engineering at Clayton (Vic.); the Division of Mineralogy at Perth (W.A.), North Ryde (N.S.W.) and Canberra (A.C.T.), the Division of Mineral Physics at North Ryde (N.S.W.), Lucas Heights (N.S.W.) and Port Melbourne (Vic.), and the Physical Technology Unit at Ryde (N.S.W.).

Department of National Development and Energy

The functions of the National Coal Research Advisory Committee which was established in 1964 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 covering geology, ore genesis and exploration techniques, mining and rock mechanics, mineral processing, ecology, energy, analytical methods and miscellaneous other items.

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, Fifth and Sixth International Tin Agreements, which came into force on 21 February 1962, 21 March 1967, 1 July 1971, 1976 and 1982 respectively. Australia joined the Fourth, Fifth and Sixth 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, and those of the Fifth in Year Book No. 66, page 376.

The objectives and provisions of the present (Sixth) Agreement are broadly similar to those of 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. The Sixth Agreement provides for a larger buffer stock than in the previous Agreements of up to 50,000 tonnes of tin metal. For the first time, financing of the buffer stock is to be shared equally between producers and consumers. In the event of persistent market disequilibrium through causes beyond the control of the buffer stock mechanism, the agreement 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, Indonesia, Malaysia, Nigeria, Thailand, Zaire; *Consumers*—Belgium-Luxembourg, Canada, Denmark, Finland, France, Germany (Federal Republic of), Greece, India, Ireland (Republic of), Italy, Japan, Netherlands, Norway, Poland, Sweden, Switzerland, United Kingdom 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, Argentina, 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). The other members of the Association are 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.

The Association consists of a Conference of Ministers, which meets biennially and is the supreme authority of the Association, a Board comprising representatives of member countries which meets twice a year, and a Secretariat which is located in Geneva.

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 have received particular attention. In December 1981 the Council adopted recommendations on minimum CIF prices for bauxite and alumina sold by member countries in 1982. 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.

The 1982 meeting of the Council of Ministers was held in Jamaica in November.

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 1979-80 and were published in *Enterprise Statistics: Details by Industry Class, Australia, 1979-80* (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. A description of the statistics and broad summary tables, in respect of the 1977-78 and 1978-79 censuses and surveys are given in Chapter 17.

The following table shows key items of data for establishments in Australia for 1980-81 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.

MINING ESTABLISHMENTS: SUMMARY OF OPERATIONS BY INDUSTRY CLASS, 1980-81

Industry ASIC code	Description	Establish- ments at 30 June	Average employment over whole year(a)			Wages and salaries (b)	Stocks			Total pur- chases, transfers in and selected expenses	Fixed capital expendi- ture less Value added disposals	
			Males	Females	Persons		Turnover	Opening	Closing			
		No.	No.	No.	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	
Metallic minerals—												
Ferrous metal ores—												
1111	Iron ores	24	7,652	1,132	8,784	192,372	1,392,772	106,929	176,486	681,623	780,707	69,360
1112	Iron ore pelletising	2	742	39	781	14,586	115,502	27,909	34,937	115,515	7,015	1,369
Non-ferrous metal ores—												
1121	Bauxite	5	1,888	226	2,114	40,924	284,195	12,740	13,515	54,614	230,356	29,340
1122	Copper ores	15	4,205	273	4,478	79,942	330,835	52,076	45,682	113,249	211,192	61,166
1123	Gold ores	70	2,543	148	2,691	51,823	216,297	26,739	36,061	75,955	149,665	74,080
1124	Mineral sands	19	1,883	147	2,030	33,012	162,023	31,207	43,912	79,609	95,119	7,609
1125	Nickel ores	5	2,310	236	2,546	50,668	259,621	27,430	30,536	104,369	158,359	50,172
1126	Silver-lead-zinc ores	12	6,808	387	7,195	131,690	617,618	78,987	90,903	185,811	443,724	91,048
1127	Tin ores	78	1,899	134	2,033	29,238	143,440	11,268	14,833	53,744	93,262	21,857
1128	Uranium ores	3	578	103	681	14,355	225,304	18,480	53,818	87,522	173,119	178,119
1129	Non-ferrous metal ores n.e.c.	17	1,489	210	1,699	31,232	155,279	29,180	36,665	58,747	104,016	21,000
11	Total metallic minerals	250	31,997	3,035	35,032	669,843	3,902,888	422,945	577,348	1,610,756	2,446,534	605,119
Coal, oil and gas—												
1201	Black coal	123	28,280	707	28,987	678,189	2,708,587	240,269	297,030	1,061,414	1,703,934	722,327
1202	Brown coal	3	3,786	329	4,115	97,298	1,934,601	66,464	101,140	319,848	1,649,429	563,044
1300	Oil and gas	14										
Construction materials—												
1401	Sand and gravel	342	1,663	198	1,861	27,058	184,734	11,264	13,411	85,932	100,949	8,883
1404	Construction materials n.e.c.	459	4,272	457	4,729	72,824	369,759	31,304	35,145	173,478	200,122	32,124
14	Total construction materials	801	5,935	655	6,590	99,883	554,492	42,568	48,556	259,409	301,071	41,007
Other non-metallic minerals—												
1501	Limestone	50	700	16	716	12,012	46,127	8,575	10,586	25,515	22,623	59,562
1502	Clays	124	380	38	418	5,213	35,927	4,027	4,439	20,074	16,265	2,004
1504	Salt	24	614	90	704	13,145	53,230	6,759	10,502	24,207	32,765	23,223
1505	Non-metallic minerals n.e.c.	125	1,118	108	1,226	18,898	93,267	13,972	14,870	52,990	41,175	3,779
15	Total other non-metallic minerals	323	2,812	252	3,064	49,268	228,550	33,332	40,397	122,786	112,828	88,567
Total mining												
(excl. services to mining)												
		1,514	72,810	4,978	77,788	1,594,480	9,329,118	805,579	1,064,471	3,374,214	6,213,795	2,020,062

(a) Includes working proprietors.

(b) Excludes amounts drawn by working proprietors.

Mineral production

This section contains details of the output (quantity and value) of principal 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.

Quantity of minerals produced

The following tables show particulars of the quantities of principal minerals produced and contents of principal metallic minerals produced during 1980-81 and earlier years. Further data are available relative to all minerals in the annual publication *Mineral Production, Australia* (8405.0)

QUANTITY OF PRINCIPAL MINERALS PRODUCED

<i>Mineral</i>		1978-79	1979-80	1980-81
METALLIC MINERALS				
Bauxite	'000 tonnes	25,541	27,629	25,450
Copper concentrate	"	819	812	866
Gold bullion (a)	kg	18,765	16,805	13,806
Iron ore	'000 tonnes	84,595	96,998	93,754
Lead concentrate	"	658	654	622
Lead-copper concentrate	tonnes	24,719	24,185	22,328
Manganese ore—				
Metallurgical grade	'000 tonnes	1,385	2,173	1,485
Mineral sands—				
Ilmenite concentrate (b)	"	1,207	1,336	1,259
Rutile concentrate	"	269	301	273
Zircon concentrate	"	454	447	461
Nickel concentrate	"	353	347	404
Tantalite-columbite concentrate	tonnes	127	166	235
Tin concentrates	"	22,618	23,083	24,204
Tungsten concentrates—				
Scheelite concentrate	"	3,129	3,864	3,800
Wolfram concentrate	"	1,840	2,411	2,463
Uranium concentrate	"	701	837	2,523
Zinc concentrate	'000 tonnes	879	903	845
COAL				
Black coal—				
Bituminous	'000 tonnes	75,332	74,402	88,766
Sub-bituminous	"	5,865	6,847	7,308
Brown coal—				
For briquettes	"	3,006	3,350	2,891
Other	"	29,095	29,544	29,212
Briquettes	"	1,131	1,253	1,081
OIL AND GAS				
Crude oil (stabilised)	'000 m ³	24,839	23,647	23,008
Natural gas	mill. m ³	7,686	8,876	10,269
Ethane	"	144	147	140
CONSTRUCTION MATERIALS(c)				
Sand	'000 tonnes	23,855	26,241	27,285
Gravel	"	13,958	14,998	14,338
Crushed and broken stone	"	54,223	56,123	53,891
Other (decomposed rock etc.)	"	32,899	38,072	41,162
OTHER NON-METALLIC MINERALS				
Asbestos (chrysotile)	tonnes	67,514	90,524	73,416
Brick, clay and shale	'000 tonnes	8,028	9,005	8,146
Limestone (including shell and coral)	"	10,813	11,521	11,894
Salt	"	5,339	5,335	6,799
Silica	"	1,618	1,884	1,828

(a) Includes alluvial gold. (b) Includes ilmenite from which titanium dioxide is not commercially extractable and beneficiated ilmenite. (c) Excludes dimension stone.

CONTENTS OF PRINCIPAL METALLIC MINERALS PRODUCED

<i>Contents of metallic minerals produced</i>		1978-79	1979-80	1980-81
Alumina (Al ₂ O ₃)	'000 tonnes	n.p.	n.p.	n.p.
Antimony	tonnes	1,588	1,435	1,207
Beryllium oxide (BeO)	mtu(a)	—	—	—
Bismuth	kg	n.p.	n.p.	n.p.
Cadmium	tonnes	1,660	1,757	1,676
Cobalt	"	3,451	3,133	3,513
Copper	"	238,688	235,122	246,441
Gold	kg	19,584	18,273	15,991
Iron(b)	'000 tonnes	53,248	61,319	59,064
Lead	tonnes	423,492	n.p.	381,377
Manganese	"	662,326	1,039,141	717,209
Mercury	kg	—	—	—
Monazite	tonnes	17,385	14,033	12,676
Nickel	"	80,385	64,393	73,367
Palladium	kg	175	202	464
Platinum	"	69	83	69
Selenium	tonnes	—	—	63
Silver	kg	874,075	791,760	759,290
Sulphur	tonnes	398,616	369,358	338,734
Tantalite-columbite (Ta ₂ O ₅ + Nb ₂ O ₅)	kg	63,771	69,113	91,930
Tin	tonnes	12,011	12,379	12,690
Titanium dioxide (TiO ₂)	"	958,499	1,028,859	1,008,386
Tungstic oxide (WO ₃)	mtu(a)	355,771	449,372	451,245
Yttrium oxide (Y ₂ O ₃)	kg	6,060	7,273	9,187
Zinc	tonnes	498,484	518,040	581,887
Zirconium dioxide (ZrO ₂)	"	301,295	297,961	306,079

(a) Metric ton unit (mtu) equals 10 kilograms.
contained in iron concentrate.

(b) Excludes iron content of iron oxide not intended for metal extraction. Includes iron

Value of minerals produced

The following table shows the value of principal minerals produced during 1980-81 and earlier years. Further data are available in the annual publication *Mineral Production, Australia* (8405.0).

VALUE OF PRINCIPAL MINERALS PRODUCED
(**\$'000**)

<i>Mineral</i>	<i>1978-79</i>	<i>1979-80</i>	<i>1980-81</i>
METALLIC MINERALS			
Bauxite	n.p.	n.p.	n.p.
Copper concentrate	256,469	327,471	288,768
Gold bullion(a)	101,592	203,337	184,434
Iron ore	801,636	1,004,308	1,007,307
Lead concentrate	339,400	623,973	375,018
Lead-copper concentrate	16,531	41,193	23,904
Manganese ore—			
Metallurgical grade	60,465	95,737	59,207
Mineral sands—			
Ilmenite concentrate(b)	23,768	27,252	33,200
Rutile concentrate	51,267	76,481	82,301
Zircon concentrate	27,189	28,175	30,180
Nickel concentrate	n.p.	n.p.	n.p.
Tantalite-columbite concentrate	5,202	12,339	17,594
Tin concentrate	135,365	166,674	143,343
Tungsten concentrate—			
Scheelite concentrate	28,147	34,923	33,739
Wolfram concentrate	15,106	19,768	19,606
Uranium concentrate	47,832	62,342	192,755
Zinc concentrate	138,464	174,065	188,075
COAL			
Black coal—			
Bituminous	1,581,702	1,665,489	2,276,080
Sub-bituminous	64,847	94,607	116,380
Brown coal—			
For briquettes
Other	79,630	91,821	107,052
Briquettes	25,063	24,938	22,230
OIL AND GAS			
<i>Oil and Gas</i>	<i>919,793</i>	<i>1,190,260</i>	<i>1,665,786</i>
CONSTRUCTION MATERIALS(c)			
Sand	62,458	76,738	95,958
Gravel	44,091	52,612	61,030
Crushed and broken stone	204,547	252,376	263,159
Other (Decomposed rock etc.)	39,322	54,141	80,768
OTHER NON-METALLIC MINERALS			
Asbestos (chrysotile)	21,149	27,240	25,735
Brick clay and shale	15,513	23,054	23,706
Gems			
Opal(d)	43,128	64,135	49,490
Sapphire	23,817	24,672	19,783
Limestone (incl. shell and coral)	39,193	42,585	44,153
Salt	38,091	40,871	66,485
Silica	11,531	14,362	15,858

(a) Includes alluvial gold. (b) Includes ilmenite from which titanium dioxide is not commercially extractable and beneficiated ilmenite. (c) Excludes dimension stone. (d) Partly estimated.

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 and oil shale)

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 and oil shale* 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 private mineral exploration other than for petroleum and oil shale in Australia during the last six years.

PRIVATE MINERAL EXPLORATION (OTHER THAN FOR PETROLEUM AND OIL SHALE)

	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
Expenditure (\$'000)—						
On drilling	30,531	36,139	50,019	50,729	72,408	114,583
Other	69,450	97,835	108,378	131,780	213,722	319,915
Australia	99,982	133,974	158,397	182,509	286,130	434,498
Metres drilled ('000)—						
Drilled-core	456	469	410	639	617	1,065
Drilled-non-core	1,553	1,364	1,919	1,689	2,299	2,718
Australia	2,010	1,834	2,329	2,328	2,917	3,783

Oil shale exploration

Statistics of exploration for oil shale are derived from an annual exploration census conducted by the Australian Bureau of Statistics.

Exploration consists of the search for and/or appraisal of new ore occurrences and known deposits of oil shale (including extensions to deposits being worked) by geological, geophysical, geochemical and other methods (including drilling). 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 operations (including the construction of drives, shafts, winzes, etc. in underground mines, and overburden removal, for open-cut extraction).

In 1980-81 expenditure in Australia on private exploration for oil shale amounted to \$38,660,000 with 142,000 metres being drilled.

Petroleum exploration

Source of statistics

These statistics of expenditure on petroleum exploration have been obtained by the addition of values collected in a quarterly survey conducted by the Australian Bureau of Statistics. Other data shown were collected by the Bureau of Mineral Resources, Geology and Geophysics. Further information relating to petroleum exploration is published by the Australian Bureau of Statistics in its annual publication *Mineral Exploration, Australia* (8407.0) and by the Bureau of Mineral Resources in *The Petroleum Newsletter* (issued quarterly) and *The Australian Mineral Industry Annual Review*.

Scope

Petroleum exploration consists of the search for and/or appraisal of deposits of crude oil and/or natural gas and natural gas liquids by geological, geophysical, geochemical, and other exploration methods, including drilling. Included in the expenditure are the costs of drilling exploratory oil and/or gas wells and the testing of such wells. Also included are the 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.

PETROLEUM EXPLORATION

		1978-79	1979-80	1980-81
Expenditure—				
Private sources	\$'000	163,366	294,709	368,330
Government sources	\$'000	4,737	5,020	5,351
Total	\$'000	168,103	299,729	373,683
Wells (a)—				
Drilled (i.e. those which reached final depth)—				
As oil producers	No.	7	1	14
As gas producers	No.	3	8	24
As oil and gas producers	No.	—	—	—
Plugged and abandoned	No.	43	43	56
Total	No.	53	52	94
Average final depth of wells drilled	m	1,973	2,460	1,747
Drilling still in progress at 31 December (uncompleted holes)	No.	3	4	11
Wells drilled or drilling over 3,000 metres	No.	10	14	24
Metres drilled (a)—				
Completed wells	m	104,583	127,403	180,157
Uncompleted holes	m	5,026	10,205	19,151
Total	m	109,609	137,608	199,308

(a) Source: Bureau of Mineral Resources, Geology and Geophysics. Data relates to years ended 31 December.

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.

PRODUCTION (a) OF PRINCIPAL MANUFACTURED PRODUCTS OF MINERAL ORIGIN

Commodity		1978-79	1979-80	1980-81
METALS(b)				
Non-ferrous—				
Alumina	'000 tonnes	6,921	7,290	7,235
Refined aluminium	tonnes	264,798	283,006	344,953
Blister copper (c)	"	170,458	163,608	170,420
Refined copper	"	137,863	137,000	159,437
Lead bullion (for export)(c)	"	162,185	167,744	149,027
Refined lead	"	217,992	204,287	206,127
Refined zinc	"	308,622	299,606	273,552
Refined tin	"	4,857	5,249	4,669
Ferrous—				
Pig iron	'000 tonnes	7,349	7,481	7,335
Steel ingots	"	7,431	7,374	7,012
Precious—				
Refined gold (d)	kg	15,563	15,038	12,494
Refined silver	"	302,032	293,966	315,584
FUELS				
Coal products—				
Metallurgical coke	'000 tonnes	4,620	4,367	4,676
Brown coal briquettes	"	1,131	1,253	1,081
Petroleum products—				
Diesel-Automotive oil	'000 tonnes	5,612	5,958	6,137
Industrial fuel and marine fuel	"	1,200	991	985
Fuel oil for burning	"	4,223	4,674	3,854
Automotive petrol	mil. litres	13,850	14,370	14,002
BUILDING MATERIALS				
Clay bricks	millions	1,914	2,172	2,287
Portland cement	'000 tonnes	5,085	5,201	5,656
Plaster of paris	"	347	419	n.p.
Plaster sheets	'000 sq m	48,508	54,770	63,617
CHEMICALS				
Sulphuric acid	'000 tonnes	1,940	2,172	1,976
Caustic soda	tonnes	n.p.	n.p.	n.p.
Superphosphate(e)	'000 tonnes	3,680	4,202	3,557

(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) Newly-won gold of Australian origin. (e) Includes double and triple superphosphate and ammonium phosphate expressed in terms of single superphosphate, i.e. 22% P₂O₅ equivalent.

Overseas trade

Exports and imports

For 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. See Chapter 24. Overseas Transactions.

Considerable quantities of metallic ores, concentrates, slags, and residues are exported from Australia for refining overseas. The following table shows selected items exported during 1981 and their principal metallic content as estimated by assay.

PRINCIPAL METALLIC CONTENTS OF SELECTED ORES AND CONCENTRATES ETC. EXPORTED FROM AUSTRALIA, 1981

Ores and concentrates, etc.	<i>Metallic contents—estimated from assay</i>							
	Copper	Lead	Zinc	Tin	Iron	Tungstic Oxides	Gold	Silver
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	kg	kg
Copper concentrate	36,885	—	—	—	—	—	371	7,772
Blister copper	18,153	—	—	—	—	—	1,913	5,155
Copper matte, slags, etc. (a)	2,071	3,160	—	—	—	—	—	1,268
Lead concentrate	4,212	22,264	6,249	—	—	—	1,164	62,409
Lead bullion	—	136,593	—	—	—	—	9	333,498
Lead slags and residues	5	4,159	—	49	—	—	10	496
Zinc concentrate	116	7,232	230,039	—	—	—	6	32,564
Zinc slags and residues	—	—	4,542	—	—	—	—	—
Tin concentrate	—	—	—	7,304	—	—	—	—
Iron ore—								
Pellets	—	—	—	—	1,629	—	—	—
Fines	—	—	—	—	23,825	—	—	—
Lump	—	—	—	—	19,380	—	—	—
Scheelite concentrate	—	—	—	—	—	2,891	—	—
Wolfram concentrate	—	—	—	—	—	1,443	—	—
Total metallic content	61,444	173,408	240,830	7,353	44,834	4,334	3,474	443,162

(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)

Period	METALS(a)									
	Tin			Aluminium			Gold		Silver	
	Aust. (\$A—tonne)	L.M.E. (£Stg—metric ton)	Straits (\$Mal—picul)	Nickel U.S.A. (\$US—lb)	Aust. (\$A—tonne)	U.S.A. (USc—lb)	Premium markets (\$A—f. oz) Australia and Overseas	U.K. (\$US—f. oz)	Aust. (\$A—kg)	U.K. (Sig new pence—f. oz)
1980	15,440.51	7,225.74	2,160.36	3.43	1,501.83	76.76	547.45	606.11	615.92	898.11
1981	13,363.32	7,071.44	(b)32.34	3.45	1,501.25	61.05	407.22	459.99	298.82	515.07
1981										
Highest	15,287.00	8,560.00	(b)35.84	3.47	1,545.00	73.62	508.80	599.25	425.99	671.20
Lowest	11,733.00	5,750.00	(b)28.57	3.25	1,370.00	50.40	346.60	391.75	231.64	412.80
Period	Copper			Lead			Zinc			
	Aust. (\$A—tonne)	L.M.E. (£Stg—metric ton)		Aust. (\$A—tonne)	L.M.E. (£Stg—metric ton)	U.S.A. (USc—lb)	Aust. (\$A—tonne)	L.M.E. (£Stg—metric ton)	Prod. (Sig—ton)	U.S.A. (USc—lb)
1980	1,959.15	941.21		843.27	388.68	42.87	713.10	327.37	798.00	38.61
1981	1,535.83	863.82		662.53	362.69	37.30	798.54	424.01	914.04	45.44
1981										
Highest	1,620.00	1,036.00		725.00	509.00	46.00	889.00	559.00	1,000.00	50.00
Lowest	1,440.00	754.00		650.00	277.00	30.00	716.00	307.00	825.00	41.25

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)
1980	135.99	142.70-146.79	18.50-20.50	320.00-350.00	53.33-62.50
1981	112.55	140.54-144.63	24.00-25.00	288.33-299.17	82.08-87.08
1981					
Highest	124.50	154.00	25.00	300.00	105.00
Lowest	105.60	120.00	24.00	270.00	75.00

(a) Where a daily price does not actually exist for a commodity, daily prices have been imputed from price data which are available.

(b) Shown in \$-kg.

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 during 1981 are reviewed briefly in subsequent parts of this section. Additional information on developments in the industry is available in *Australian Mineral Industry Annual Review 1980* 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. The *Australian Mineral Industry Quarterly*, Volume 34, Number 4, details Australia's identified mineral resources, 1981.

General Review of 1981

The gross domestic product (GDP) of Australia in 1981 was \$140,783 million, of which an estimated \$6,000 million was generated by the mineral industry, excluding smelting and refining. If smelting and refining were included, an estimated \$2,400 million could be added to this figure, thus making the mineral industry the largest primary sector contributor to the GDP. Australia's export trade again increased in total value, although in real terms a decline was evident. Japan, USA and EEC were the main markets for mineral commodities.

Increased output and higher prices for some major commodities were sufficient to bring about yet another record ex-mine value of minerals produced in Australia in 1981 of about \$8,759 million. The greater part of this increase was accounted for by the energy minerals, coal, crude oil and natural gas. Most other major commodities recorded downturns in quantities and values of production reflecting a continuation of gloomy conditions on world markets. Tin, gold, and silver output was higher than in 1980, but output of lead, copper, nickel, and silver was lower. Production of uranium oxide (yellowcake) almost doubled because of output from the newly operational mine and concentrator at Ranger, N.T. The downturn in the world steel industry resulted in reduced demand for Australian iron ore and manganese, although there was a slight increase in demand for Australian steel products. Because of reduced demand for rutile, and increased supplies, Australian mineral-sands operators cut back production, particularly on the east coast.

Imports—1981

The value of imports for mineral products rose by 10 per cent to \$2,372 million. Crude oil and other refinery feedstock was the largest single mineral import, rising by 16 per cent to \$2,011 million. Other significant mineral imports were gem diamonds and fertiliser materials (phosphate rock, elemental sulphur, and potassium salts). Imports of mineral primary products accounted for 9.8 per cent of the total value of merchandise imports compared with 12 per cent in 1980. Although the value of imports rose, the surplus in the balance of mineral trade rose substantially, increasing from \$4,671 million in 1980 to \$4,700 million in 1981.

Exports—1981

Australia's mineral exports rose in current dollars by 3 per cent to \$7,072 million, a new record, but declined somewhat in real terms. Those mineral commodities which lost ground in current dollars as a result of depressed world industrial and trading conditions included gold, iron ore, lead, nickel, rutile, silver, tin, copper and zinc. However, black coal exports increased in both quantity and current dollar terms and remained the largest single export earner, accounting for \$2,301 million or 36 per cent of the total value of mineral primary products.

Iron ore was the second largest export earner with a value of \$1,123 million (a decrease of 4 per cent) followed by alumina which increased in value by 6 per cent to \$1,086 million. In total, black coal, iron ore and alumina accounted for nearly 64 per cent of the total value of exports of mineral primary products.

Pattern of mineral trade—1981. Australia exported metals and minerals to more than 100 countries. Japan accounted for 46.3 per cent of Australian exports by value. Principal exports of mineral primary products to Japan were black coal, iron ore, aluminium, alumina, bauxite, copper, nickel, manganese ore and mineral sands.

The proportion by value of Australian mineral exports to the EEC was 17.5 per cent (including 5.5 per cent to the UK), and to the USA 11.6 per cent. To the EEC countries, exports were mainly iron ore, black coal, lead and copper, and to the USA alumina, nickel, bauxite, manganese ore, mineral sands, iron ore, lead, and zinc.

Bauxite, Alumina and Aluminium

In 1981, production of bauxite increased by 6 per cent to 25.54 million tonnes, alumina production to 7.1 million tonnes, while aluminium output was up 25 per cent to 379,000 tonnes. Australia was again the world's largest producer of bauxite and alumina.

The commissioning of the new alumina refinery at Wagerup, W.A., has been delayed until at least mid-1983. Initial rated capacity is to be 500,000 tonnes per year.

The first stage of the alumina refinery at Worsley, W.A., will be completed in 1983. Initial rated capacity is one million tonnes per year, with ultimate capacity of two million tonnes per year. Bauxite will be supplied from Mount Saddleback, W.A. All alumina produced will be exported.

Construction of the third potline at the Kurri Kurri, N.S.W., aluminium smelter has been deferred due to the depressed world aluminium market. The planned expansion will increase total capacity from 90,000 to 135,000 tonnes per year. Comalco's aluminium smelter at Boyne Island, near Gladstone, Qld, is supplied with alumina from the nearby Queensland Alumina Ltd (QAL) refinery. The smelter has a first stage design capacity of 103,000 tonnes per year and it is planned to expand capacity to 412,000 tonnes by the end of the decade. The rated capacities of the other two Australian aluminium smelters, at Point Henry, Vic., and Bell Bay, Tas., are 165,000 and 117,000 tonnes per year respectively. Point Henry uses Western Australian alumina while Bell Bay obtains its alumina from Queensland.

Construction of the Portland, Vic., smelter, which was to be commissioned in 1983, has been delayed. Initial capacity is to be 132,000 tonnes per year. The Tomago, N.S.W. smelter, to be commissioned in mid-1983, is proceeding to schedule and will have an initial capacity of 110,000 tonnes per year. The proposed Lochinvar, N.S.W., smelter has been abandoned.

Copper

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

In 1981, mine production of copper decreased to 231,339 tonnes.

Work on two significant copper-zinc deposits near Benambra, Victoria, continues to delineate further base-metal resources.

Exploration drilling is continuing at the copper-uranium-gold prospect at Olympic Dam on Roxby Downs, S.A. where an exploration shaft is being sunk. Additional drilling at Balcooma, in northwest Queensland to obtain representative bulk samples for metallurgical testing has outlined mineralisation with 3 per cent copper and some lead, zinc and silver.

At Tennant Creek, N.T., the copper smelter and the Gecko mine were closed in late 1981 because of low copper prices. Copper ore is being mined at the Warrego mine and trucked to Mount Morgan, Qld, for smelting.

Drilling near Goonumble, near Parkes, N.S.W., has outlined possible resources of 86.4 million tonnes of 0.62 per cent copper and 0.59 g/tonne gold plus 166 million tonnes of 0.74 per cent copper, 0.12 g/tonne gold and 1.77 g/tonne silver.

Iron

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

Mine production of iron ore in 1981 was 84.7 million tonnes, nearly 11 per cent lower than in 1980. Export of iron ore and iron ore pellets was 71.1 million tonnes valued at \$1,123 million. Australia was the world's second largest exporter of iron ore in 1981 and the third largest producer.

Construction to extend mining along Robe River to East Deepdale was substantially completed in 1981. Large reserves of pisolitic limonite ore has been shown to exist at Yandicoogina, W.A. Total

reserves are 2,943 million tonnes, including 443 million proved reserved, 800 million probable and 1,700 million possible. The average ore content is 58.5 per cent iron, 10 per cent water, 4.5 per cent silica and 1.5 per cent alumina.

Additional reserves have been proved in the Sunrise Hill—Shay Gap area enabling mining to continue to the end of the 1980s.

Silver, lead and zinc

Mine production of lead and zinc metal in 1981 was 393,113 tonnes and 504,210 tonnes respectively, with lead being 9 per cent less and zinc metal 2 per cent more than in 1980.

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.

Production from the Que River lead-zinc-silver mine (Tasmania) reached the scheduled rate of 200,000 tonnes during the year 1981. Ore is treated at the Rosebery concentrator, and zinc concentrates refined at the Risdon refinery. Construction of the mine and treatment plant continued on schedule at the Elura lead-zinc silver deposit near Cobar, N.S.W. A decline shaft was begun in mid-1981 and production is expected to commence in late 1982. Zinc concentrates will be shipped to the Risdon (Tasmania) refinery. Published reserves are 27 million tonnes averaging 8.3 per cent zinc, 5.6 per cent lead and 139 g/tonne silver. A zone of potentially economic mineralisation about 2 kilometres north of the Hilton lead-zinc-silver mine (to be commissioned in 1984-85) near Mount Isa, Qld has been discovered. It is described as of similar size to the Hilton block where there are probable reserves of 45 million tonnes averaging 9.6 per cent zinc, 6.6 per cent lead and 150 g/tonne silver.

Exploration continues at Thalanga, Lady Loretta and Dugald River deposits in Queensland, Benambra, Vic., and Sorby Hills, W.A.

Black coal

Raw coal production in 1981 was about 110.9 million tonnes, almost 20 per cent higher than in 1980. Estimated saleable output also increased by about 20 per cent to 92.1 million tonnes. Total domestic consumption increased slightly from 36.4 million tonnes in 1980 to 37.4 million tonnes in 1981, although growth in both domestic consumption and consumption in the world steel industry was restricted. In 1981 exports were 50.7 million tonnes valued at \$2,301 million, with Japan being the major market.

Increasing demand for steaming coal, particularly from Japan, has resulted in exports of steaming coal rising to almost 10.5 million tonnes in 1981. As a result, new mines have been opened and others are under 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.

A paper entitled Coal Exploration in Australia has been published in the *Australian Mineral Industry Quarterly*, Vol. 31, No. 1. and Vol. 34, No. 2.

Petroleum

At the end of 1981 there were 18 fields producing stabilised crude oil (which includes condensate marketed as part of a crude oil stream): Moonie, Alton, Conloi, Kincora, Cabawin, Bennett, Silver Springs and Trinidad in Queensland; Barrow Island, Yardarino and Dongara in Western Australia; and Barracouta, Halibut, Mackerel, Cobia, Tuna, Kingfish and Marlin offshore from Victoria in Bass Strait. The production of stabilised crude oil in 1981 amounted to 22.8 million kilolitres, an increase of 2.7 per cent over the 1980 production level.

Natural gas production in 1981 was 11.3 million cubic metres, an increase of about 18 per cent over the 1980 production level. About 12 per cent of natural gas production was used in the field and processing plants, the balance being sold mainly as fuel to markets in New South Wales, Queensland, Victoria, South Australia and Western Australia.

Sixteen offshore exploration wells were drilled in 1981, two less than in 1980. However, during the first half of 1982 twenty-seven offshore exploration wells were drilled. Metres drilled decreased from 62,012 in 1980 to 44,946 in 1981. At 30 June 1982 there were seven offshore drilling vessels operating in Australian waters.

Offshore development drilling continued in 1981 in the Gippsland Basin on the Tuna platform (7 wells) and the Snapper platform (6 wells). The West Kingfish platform was installed in August 1981 and the Cobia platform in February 1982. The jacket for the Fortescue platform was completed in August 1982 ready for installation while at that time the Flounder platform was in the early stages of construction. Major development work commenced on the North West Shelf project during 1982 and by September the jacket for the first offshore platform was in position and work was in progress on the platform, site preparation for onshore treatment facilities and laying of the underwater pipeline.

Onshore exploration drilling activity rose from 77 wells in 1980 to 142 in 1981. During the first half of 1982 75 exploration wells were drilled. Metres drilled increased from 137,296 in 1980 to 325,651 in 1981. Drilling in 1981 was mainly centred in the Bowen-Surat Basin in Queensland, the Cooper Basin in South Australia and the Perth, Carnarvon and Canning Basins in Western Australia.

Forty-three onshore development wells were drilled in 1981, 21 more than in 1980. Metres drilled more than doubled from 37,484 in 1980 to 85,232 in 1981. New developments included commencement of construction of the Cooper Basin liquids scheme whereby petroleum liquids will be piped 659 kilometres from the Cooper Basin to a fractionation plant at Stony Point near Whyalla.

Production leases were granted for the Mereenie oil field in November 1981 following agreement with the Aboriginal land owners on royalties. A 20 well, two year appraisal program is under way and further assessment of the resource is expected as more wells are drilled. Present oil reserves are estimated at 64 million barrels and recoverable gas reserves are put at 0.9 TCF. A contract was signed in November 1981 for the use of Palm Valley gas in power generation at Alice Springs. Tenders for construction of a pipeline between Palm Valley and Alice Springs are to be called in late 1982.

In 1981 there were seven significant oil discoveries and 20 significant gas discoveries.

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 74,355 tonnes in 1981. Australia was the fourth largest world producer. Production from Agnew, W.A., mine is being increased to reach 15,000 tonnes per year 'contained nickel' by 1984. The Mount Windarra mine reopened in 1981. The concentrates are toll-smelted at the Kalgoorlie smelter, together with those from Kambalda-St Ives-Nepean and the Carnilya Hill mine.

Mineral sands

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

Australia is still the world's largest producer and exporter of natural rutile, ilmenite, zircon and monazite. Output of rutile, ilmenite and zircon concentrates was severely reduced but the production of monazite concentrates was maintained.

Diamonds

A detailed feasibility study is underway on the AKI kimberlite pipe in the Argyle area W.A., with a view to commercial production, possibly by 1985. Production from the smaller but high-grade Smoke Creek alluvials is also planned to begin on a small scale in 1983 with full-scale production planned for 1985 at an annual rate of 20 million carats.

Uranium

Government approval has been given for the development of mines at Jabiluka, N.T., Lake Way, W.A., and Honeymoon, S.A. This makes seven uranium ore mining and treatment projects with Commonwealth approval, the others being Yeelirrie, W.A., and the producing mines at Mary Kathleen, Qld, Ranger, N.T., and Nabarlek, N.T. (mined-out, but will produce yellowcake for some years).

An exploration shaft is being sunk at the large copper-gold-uranium prospect at Olympic Dam, on Roxby Downs, S.A., to obtain bulk samples for metallurgical testing. A decision on the development of the Yeelirrie project will be made by the operator in the near future. The open-cut mine and treatment plant at Ranger are in full operation and yellowcake is being exported. Total identified resources at Ranger 1 are about 124,700 tonnes U_3O_8 . The Mary Kathleen mine and treatment plant will close in late 1982.

Mine production of U_3O_8 (yellowcake) in Australia in 1981 was 3,373 tonnes (2,860 tonnes contained U), and exports 1,625 tonnes of yellowcake.

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 Concentration Statistics, Australia* (8411.0), contains economic statistics of the industry prepared and published as soon as possible after the data have been compiled. 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* (8302.0). For uranium industry see Annual Reports of the Australian Atomic Energy Commission.

