

CHAPTER XXVI

MINERAL INDUSTRY

NOTE.—Further detailed information on the subjects dealt with in this chapter is contained in the annual printed bulletin *Non-Rural Primary Industries and Value of Production* issued by this Bureau, and in *The Australian Mineral Industry—Annual Review* and other publications issued by the Bureau of Mineral Resources, Geology and Geophysics, which also issues, in co-operation with this Bureau, a quarterly publication *The Australian Mineral Industry*, comprising two parts—Part I.—Quarterly Review, and Part II.—Quarterly Statistics. The mimeographed statistical bulletin *Mining and Quarrying* of this Bureau contains annual statistics of the industry prepared and published as soon as possible after the data have been compiled. A monthly statistical bulletin *The Gold Mining Industry, Australia* is issued also, and other current information on mining or mine products is contained in the *Quarterly Summary of Australian Statistics*, the *Monthly Review of Business Statistics*, the *Digest of Current Economic Statistics* and the *Monthly Bulletin of Production Statistics*.

§ 1. Mineral Resources, Administration and Research

1. Occurrences of Minerals.—The greatest part of the area of outcropping rock on the Australian continent is Precambrian in age. These basement rocks form the western and central core of the continent and are flanked by younger Palaeozoic rocks which, along the eastern edge of the continent, form a belt several hundred miles wide extending from north Queensland to Tasmania. Smaller areas of Palaeozoic rocks occur in other States. Mesozoic sediments overlies large areas of the continent and reach their greatest development in central Queensland. Cainozoic rocks occur mainly in the southern parts of Victoria and South Australia and as residual basalt cappings over an extensive area of the Palaeozoic rocks of eastern Australia.

Minerals occur widely throughout the Precambrian and Palaeozoic rocks of the continent. Palaeozoic mineralization is perhaps more varied, but the deposits now being worked are in general smaller than those found in Precambrian rocks. Most of the larger deposits of minerals now being mined in Australia are shown in the following table according to the age of the geological formation in which they are found.

PRINCIPAL AUSTRALIAN MINERAL DEPOSITS

Age of geological formation in which located	Metal or mineral	State or Territory	Locality
Precambrian (more than 520 million years old)	Copper ..	Queensland ..	Mount Isa
		Northern Territory	Tennant Creek
	Gold	Western Australia	Kalgoortie and other localities
	Iron	South Australia ..	Middleback Ranges
		Western Australia	Yampi Sound and Pilbara
	Lead-silver-zinc	New South Wales	Broken Hill
		Queensland ..	Mount Isa
	Uranium ..	Queensland ..	Mary Kathleen
		Northern Territory	Rum Jungle and South Alligator River area
	Palaeozoic (between 200 and 520 million years old)	Black coal ..	New South Wales	Hunter Valley, Lithgow, South Coast
		Queensland ..	Kianga-Moura, Baralaba, Bowen, etc.
		Western Australia	Collie
Copper-gold ..		Queensland ..	Mount Morgan
		Tasmania ..	Mount Lyell
Lead-silver-zinc		Tasmania ..	Mount Read and Rosebery
Tin (tode) ..		Queensland ..	Herberton
		Tasmania ..	North-east of State
Tungsten ..		Tasmania ..	King Island and north-east of State

PRINCIPAL AUSTRALIAN MINERAL DEPOSITS—*continued*

Age of geological formation in which located	Metal or mineral	State or Territory	Locality
Mesozoic (between 75 and 200 million years old)	Black coal ..	Queensland .. South Australia ..	Ipswich Leigh Creek
	Manangese ..	Northern Territory	Groote Eylandt
	Bauxite ..	Queensland .. Western Australia	Weipa Darling Range
Cainozoic (less than 75 million years old)	Brown coal ..	Victoria ..	Gippsland
	Mineral sands ^(a)	New South Wales	North coast
		Queensland ..	South coast
	Tin (alluvial) ..	Western Australia	South-west coast
		New South Wales	Tingha
		Queensland .. Tasmania ..	Herberton North-east of State

(a) Derived from granites of Palaeozoic age and sandstones of Mesozoic age in eastern Australia and from granites of Precambrian age in Western Australia.

Of the non-metallic minerals, many, such as clay, sand and silica, etc., are not restricted to the rocks of any particular era and are often polycyclic in nature. However, Precambrian rocks do contain important deposits of blue asbestos in Western Australia, limestone and dolomite in South Australia, and mica in the Northern Territory. All crude salt is produced by the evaporation of water from pans constructed along the sea coast or from inland lakes.

A map showing the location of principal mining centres, mineral discoveries, and mineral processing centres appears facing page 1154.

2. **Government Administration and Assistance.**—(i) *General.* For all practical purposes all mineral rights in Australia are vested in the Crown. In the States sovereign rights are held by the State Governments with respect to mineral resources within their boundaries. In the Territories of the Commonwealth these rights are vested in the Commonwealth Government. The Commonwealth Government, in addition, is able to influence 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.

The Commonwealth Government maintains export controls over certain minerals and metals. These controls are enforced by means of Customs (Prohibited Exports) Regulations as amended from time to time by Statutory Rules. The Commonwealth authorities having jurisdiction over mineral and metal exports, together with the relevant products are listed below. A clearance to export is needed in each case. In November, 1964, temporary restrictions were placed on the export of copper as a result of the industrial dispute at Mt. Isa.

Department of National Development—iron ores, beneficiated iron ores and iron concentrates; mineral sands in all forms (including concentrates) containing zircon, rutile or ilmenite; lithium ores and concentrates; manganese ores; beryllium ores and concentrates.

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

Australian Atomic Energy Commission—uranium and thorium minerals including monazite; uranium, thorium, beryllium, hafnium and lithium metals, compounds and alloys; hafnium-free zirconium metals, alloys and compounds; very pure calcium metal; nickel metal in certain forms.

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

(ii) *Commonwealth Government Assistance.* Assistance provided by the Commonwealth Government takes the form of income taxation concessions, subsidies, and technical assistance mainly through the work of the Bureau of Mineral Resources and the Commonwealth Scientific and Industrial Research Organization.

(a) *Income Taxation Concessions.* One-fifth of the net income derived from mining for prescribed minerals in Australia or the Territory of Papua and New Guinea is exempt from tax. The metals or minerals to which this concession applies are as follows:—asbestos,

bauxite, chromite, emery, fluorspar, graphite, ilmenite, kyanite, magnesite, manganese oxides, mica, monazite, pyrite, quartz crystals (piezo-electric quality), radio-active ores, rutile, sillimanite, vermiculite and zircon; and ores of antimony, arsenic, beryllium, bismuth, cobalt, columbium, copper, lithium, mercury, molybdenum, nickel, osmiridium, platinum, selenium, strontium, tantalum, tellurium, tin, tungsten and vanadium.

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

Income attributable to uranium obtained from working a mining property in Australia or the Territory of Papua and New Guinea, or from the treatment of ore in Australia or the Territory to recover uranium concentrates, is exempt from tax for residents of Australia and the Territory of Papua and New Guinea. The exemption is, however, conditional upon the uranium recovered being owned by the Commonwealth or disposed of to a person approved by the Commonwealth.

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

Valuable assistance has been given in the form of certain taxation concessions to encourage the search for petroleum. Investors are permitted, for tax purposes, to deduct from their assessable income all sums paid for shares issued by petroleum exploration companies in respect of application, allotment, and call moneys. These deductions are allowable only if a petroleum exploration company elects to forego an equivalent amount when, in the event of commercial production, capital expenditure is claimed as a deduction for tax purposes. Most Australian petroleum exploration companies have elected to pass on this benefit to their shareholders. In 1963 amendments aimed at providing increased incentive to petroleum exploration companies extended the range of deductible items to include expenditure on the purchase of rights to prospect, preliminary expenses incurred in the operation of exploration companies, and several other fringe items. The effect of these concessions is to exempt a company from payment of income tax on profits derived from the sale of petroleum until such time as the capital expended in developing the production has been recouped.

Further information is given in a booklet entitled *Income Tax for the Mining Industry*, issued by the Commissioner of Taxation.

(b) *Petroleum Search Subsidy.* In 1957 the Commonwealth Government introduced the *Petroleum Search Subsidy Act 1957*, whereby stratigraphic drilling operations were subsidized to the extent of 50 per cent. of cost. The *Petroleum Search Subsidy Act 1959* widened the scope of operations for which subsidy was offered to include all types of geophysical surveys and off-structure drilling operations. Another amendment in 1961 further widened the scope of the 1959 Act to provide subsidy for test drilling and detailed structure drilling operations. It also provided for the calculation of drilling subsidies on a footage basis as an alternative to the total cost basis. A sum of £5 million was allocated to the petroleum search subsidy scheme for 1962-63. This amount was almost double the allocation of £2.7 million provided in the previous year. In spite of the increased allocation, applications for subsidy increased to such an extent that the maximum rate of subsidy was reduced in 1962-63 from 50 per cent. of the allowable cost of approved operations to 30 per cent.

The *Petroleum Search Subsidy Act 1959-1961* was amended in June, 1964, to extend Commonwealth subsidy for a further three years. The *Petroleum Search Subsidy Act 1959-1964* provides subsidy for approved geophysical surveys, test and stratigraphic drilling operations; bore-hole surveys, off-structure and detailed structure drilling are no longer eligible for subsidy. As in the previous Act, an applicant may elect to receive subsidy for both types of drilling operations on either a footage basis or a total cost basis. In addition, the production testing of any well approved for subsidy is also eligible for additional subsidy. Under the Act the Minister may vary the rates of subsidy for prescribed operations but they may not exceed one-half the total cost. The present rates of subsidy for approved operations on a cost basis are 30 per cent. for test-drilling and 40 per cent. for stratigraphic drilling. The rate for all types of geophysical operations is 30 per cent. The 1959-1964 Act also specifies that exploration for petroleum on the Australian continental shelf is eligible for subsidy, retrospective to 1959. The Federal budget for 1964-65 contained an appropriation of £5 million for subsidies under the Act.

On 28th October, 1964, the Minister announced that action was necessary to limit the burden of the Commonwealth subsidy scheme on the Australian taxpayer in view of the many recent encouraging discoveries of oil and gas which were now providing the incentive to further exploration. To this end the Minister announced that operations within certain defined areas around discovery wells and fields would not be approved for subsidy. For the present, projects in the following areas would not be eligible for subsidy: 20 miles from a gas well; 30 miles from an oil well; 40 miles from a gas field; 50 miles from an oil field.

(c) *Assistance to the Gold-mining Industry.* Assistance to the gold-mining industry by subsidy was introduced at a time of rising costs in the industry and a fixed official world price for gold. Because many producers were faced with the likelihood of closing down, the Government decided to subsidize marginal producers in Australia and the Territories of Papua and New Guinea. Under the *Gold-Mining Industry Assistance Act 1954* a producer the value of whose gold output exceeded 50 per cent. of the total value of his mine output was eligible for assistance, subject to certain conditions, on the production of gold from 1st July, 1954. The rate of subsidy payable under the original Act was increased under amendments enacted on 22nd October, 1957, and 22nd May, 1959. The Act was again amended on 2nd June, 1965. Under the Act as it now stands, the subsidy payable to small producers whose annual deliveries do not exceed 500 fine oz. is £3 per fine oz., irrespective of cost of production or rate of profit. For large producers, subject to certain provisions, subsidy is paid at the rate of three-quarters of the excess of the average cost of production over £13 10s. per fine oz. with a maximum amount of subsidy of £4 per fine oz. A producer whose deliveries during the year exceed 500 fine oz. may elect to be treated as a small producer. In this case, the subsidy rate payable per fine ounce on total deliveries is £3 reduced by 1.2d. for each fine ounce by which deliveries exceed 500 fine ounces. The benefit under this provision terminates when deliveries in a year reach 1,100 fine ounces. Where a producer receives an amount in excess of the official price of £15 12s. 6d. per fine oz. as a result of sales on overseas premium markets or otherwise, the subsidy payable is reduced by the amount of the excess. The subsidy was also limited, prior to 30th June, 1965, in the case of large producers, to the extent that the annual net profit of a producer was not, with the addition of the subsidy, to exceed 10 per cent. of the capital used in the production and sale of gold. This limitation has now been removed. The latest amendment also provided for the removal of another two restrictive provisions. A large producer's entitlement to subsidy is no longer subject to reduction if the amount of expenditure on development included in costs exceeds a certain amount, or if the recovery rate of the mine falls below nine-tenths of that for the previous year. A significant liberalization was included in a provision under which a large producer is now able to include in his costs for subsidy purposes one-half of costs incurred in approved exploratory diamond drilling elsewhere than on his mining property. Payments under the amended Act are to apply to production until 30th June, 1970.

Payments under the Act commenced in March, 1955, and the amounts paid to gold producers in the various States and Territories of Australia in each of the years 1959 to 1964 are shown in the table on page 1152.

The purpose of the *Gold Mines Development Assistance Act 1962* was to provide assistance to gold producers in Australia and the Territories of Papua and New Guinea not receiving subsidy under the *Gold-Mining Industry Assistance Act 1954-1962*, in order to increase the rate of their development work and so to add to their proved reserves of gold-bearing minerals. In recent years, these reserves had declined to the extent that the long-term prospects of the industry were jeopardized. The Act, which applied to 1962-63 and the next two financial years, provided that a development allowance was payable to a mine approved for the purposes of the scheme equal to the amount by which its allowable expenditure on development in a year, as defined in the Act, exceeded a defined base amount which would normally be the average annual amount spent by the mine on development during the three years preceding 1962-63. The payment of allowance was also subject to a number of other conditions and limits provided for in the Act. With the liberalization of the *Gold-Mining Industry Assistance Act* from 1st July, 1965, the Commonwealth Government decided not to extend the development assistance legislation, which, accordingly, lapsed on 30th June, 1965.

(d) *Assistance to the Copper Mining Industry.* After a Tariff Board investigation, assistance was accorded to the industry in 1958, partly by import duty and partly by bounty. The assistance to the industry was reviewed in 1960 and 1963, and the present bounty assistance will continue until 31st December, 1965. Under the *Copper Bounty Act 1958-1963* bounty is payable, subject to specified conditions, on refined copper sold for use in Australia. The rate of bounty is £35 a ton when the overseas price, as determined by the Minister for Customs and Excise, is £290 (£Stg.232) or less. When the overseas price rises above £290,

the bounty falls by the same extent, so that no bounty is payable when the oversea price is £325 (£Sig.260) or more. A duty is imposed on imports of copper when the oversea price falls below £290 a ton, to the extent of £1 for each £1 that the price falls below £290. Including freight and other charges, the landed cost of imported copper is thus expected not to fall below about £305 a ton.

(e) *Assistance to Producers of Sulphuric Acid and Iron Pyrites.* Following recommendations of the Tariff Board, the Sulphuric Acid Bounty Act was extended for a period of five years from 1st July, 1960. Arising from these same recommendations, the *Pyrites Bounty Act* 1960 was enacted on 15th December, 1960, to be operative for a period of four and a half years from 1st January, 1961. The Acts provide for bounties to be paid, subject to specified conditions, on sulphuric acid produced from prescribed materials of Australian origin and to producers of iron pyrites. In June, 1965, it was announced that assistance under these Acts would continue until 31st December 1965 (unless an earlier date is specified by proclamation).

(f) *Bureau of Mineral Resources.* The functions of the Bureau of Mineral Resources, Geology and Geophysics are to explore, investigate and encourage the development of mineral deposits; to survey and assess the mineral resources of the Commonwealth and its Territories and to initiate and investigate proposals for their development; to interpret the results of completed surveys and recommend ways of remedying or meeting mineral deficiencies and to advise on all aspects of the mineral economy of Australia, including the best utilization of mineral resources in the national interest; to carry out geological and geophysical surveys and investigations and advise on all aspects of applied geology and geophysics.

The Bureau comprises five branches under the Director: Operations, Mineral Resources, Geological, Geophysical, and Petroleum Exploration. The Operations Branch consists of three sections, Planning and Co-ordination, Publications and Information, and Administrative. It carries out central office functions, including planning and control of programme, assessment of results, co-ordination of activities, liaison, and distribution of information. The Mineral Resources Branch comprises the sections Mineral Economics, Mining Engineering and Petroleum Technology, and is concerned largely with those aspects of the Bureau's work which involve studies of the mineral industry as a whole, and the preparation of advice and reviews for the Government, industry and the public. The Geological and Geophysical Branches are responsible for the principal field activities of the Bureau, and the operation of observatories; while the Petroleum Exploration Branch is concerned with the administration of the Petroleum Search Subsidy Act, and is also engaged in the assessment of sedimentary basins in Australia and its Territories. The establishment of the Bureau is 536 officers of whom 280 are professional. The budget for the financial year 1963-64 was approximately £7.6 million, of which £5 million was provided for payment under the Petroleum Search Subsidy Act.

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

(g) *Commonwealth Scientific and Industrial Research Organization.* The activities of this body with respect to the mineral industry are discussed on page 1137 under Research.

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

New South Wales. State aid to assist metalliferous mining may consist of grants to assist the prospecting and/or mining for gold and minerals, and for the purchase, removal and installation of mining plant or equipment. A quantity of mechanical equipment is also available in several localities for hire at reasonable rentals to prospectors and small mine operators, and District Inspectors have geiger counters and schelite detectors which are loaned to approved persons.

Victoria. Loans may be granted to assist prospecting and development or the purchase of machinery for gold mining. The Mines Department has stamp batteries in different parts of the State to crush ore for prospectors at nominal rates. Small mining companies may avail themselves of these facilities. Drilling with diamond, rotary and percussion drills is carried out by the Mines Department for mining companies and for general mineral exploration. A survey of the State's underground water resources is in progress, in conjunction with the development of town water supplies from underground sources.

Queensland. Various forms of assistance to mining are made available by the Queensland Department of Mines. Grants are made from the Consolidated Revenue Fund for use on construction and maintenance of roads in mining areas. Advances are made from the Gold Mining Encouragement Fund for mining development work. This assistance is restricted to gold mines, and advances are repayable from proceeds of the mine, if any. From the Assistance to Metalliferous Mining Fund, plant such as jackhammers, compressors and pumps is purchased and maintained. Such plant is made available on hire, the rental payments being credited back to the fund. Prospecting assistance is made available in approved cases, the rates being £2 10s. a week for a single man and £3 10s. a week for a married man with dependants. This is not repayable. From the Advances to Mining Fund, assistance by way of subsidy is advanced for mine development. This is repayable from proceeds of the mine. The department also maintains a treatment works for tin ores, etc., at Irvinebank, an assay office at Cloncurry, and diamond-drilling plants in several parts of the State. The Venus State battery at Charters Towers is available for the treatment of gold-bearing ores.

South Australia. The Department of Mines provides the following services and facilities to the mineral industry:—(i) hire of boring plant and mining equipment, boring and testing of mineral deposits, financial subsidies in approved cases for prospecting and mining development, development of sub-surface water supplies for farming, pastoral, irrigation and mining purposes, and purchase of basic metal ores from prospectors; (ii) geological examination of mineral deposits, water supply, dam foundation and drainage problems, guidance on mining legislation, and publication and issue of geological bulletins and maps. It also provides, through the Australian Mineral Development Laboratories, chemical and metallurgical and analytical and assay investigation, testing and treatment of ores and minerals, and petrographic, mineragraphic and radiometric determinations. Pilot scale metallurgical and chemical treatment plants are maintained and operated for the development of mineral extraction processes.

Western Australia. Assistance is given to prospectors to the extent of £6 a week south of the Tropic of Capricorn, and of £7 a week north of that line; also provision is made for the supply of some tools required for prospecting.

There are twenty 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 ore to State batteries for treatment.

Provision is made for loans to mine-owners who require assistance to develop mines. The Government also has a drilling scheme, financing mine-owners on a £1 for £1 basis.

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

In consequence of a serious fall in world tungsten prices the *King Island Scheelite Agreement Act 1963 (No. 1)* was passed. This Act permitted the Tasmanian Government to provide financial assistance until the end of August, 1963, so that production of scheelite on King Island could be continued. A second Act (*King Island Scheelite Agreement Act 1963 (No. 2)*) gave authority for advances in the period to 31st May, 1964.

Northern Territory. To encourage the development of the mining industry the Northern Territory Administration has erected four government batteries for the treatment of miners' ores. Only two of these, at Tennant Creek and Mount Wells near Burrundie, are now in operation. The re-opening of the other two batteries will depend on the revival of small scale wolfram and tin mining in Hatches Creek and Maranboy where these batteries are located.

The crushing charges are subsidized by government grants. In addition, the Administration provides cartage subsidies and financial advances to encourage miners to carry out developmental work. Roads and water supply services are provided and maintained for mines under active development throughout the Territory.

3. **Research.**—Research investigations into problems of mining, ore-dressing and metallurgy are conducted by Governmental bodies, by universities, by private enterprise and by combined efforts of these bodies.

Commonwealth Scientific and Industrial Research Organization. Research for the mineral industry by the Commonwealth Scientific and Industrial Research Organization is concentrated mainly in the Divisions of Applied Mineralogy and Mineral Chemistry, and in the Mineragraphic Investigations and Ore-Dressing Investigations Sections. All of these groups have their laboratories in Melbourne. In addition, the Division of Applied Mineralogy has a small laboratory in Perth. The two Divisions are engaged in chemical research on the utilization and industrial application of minerals, both metallic and non-metallic, while the Ore-Dressing Investigations Section carries out investigations into the fundamentals of mineral processing operations. Research in the Mineragraphic Investigations Section is concerned with most aspects of mineralogy and petrology, including the examination of ores, rocks and minerals, the study of chemical element distribution in mines and mineral prospects, and the use of mineralogical techniques in problems connected with primary and secondary industry. Other sections carry out research on the properties of metals and alloys, and on the characteristics and uses of coals.

Australian Atomic Energy Commission. The Australian Atomic Energy Commission conducts research at its laboratories at Lucas Heights in Sydney on the development of nuclear power, including research on nuclear materials and on metals and ceramics used for nuclear power. Research conducted by the Commission is discussed in detail in Chapter XIX. Education, Cultural Activities and Research.

Australian Mineral Development Laboratories. Research investigations into mineral problems are undertaken by the Australian Mineral Development Laboratories in Adelaide. This organization is sponsored by the Commonwealth Government, the South Australian Government and the Australian Mineral Industries Research Association (an association of companies engaged in the mineral industry formed to foster and develop mineral research). These sponsors furnish work for the laboratories, or guarantee finance, in the proportions 25 : 50 : 25 respectively. The laboratories have sections dealing with mineralogy, petrology, chemical analysis, ore-dressing, ceramics, and extractive and physical metallurgy.

National Coal Research Advisory Committee. In December, 1964, the appointment of a National Coal Research Advisory Committee was completed, and the establishment of the Australian Coal Industry Research Laboratories was begun. These laboratories will assume the functions and the facilities of the Australian Coal Association (Research) Ltd., a subsidiary of the Australian Coal Association which is an association of colliery companies in New South Wales and Queensland. These developments have resulted from the recommendations of the Coal Utilization Research Advisory Committee made in 1962. The National Coal Research Advisory Committee, which had its inaugural meeting in Sydney in January, 1965, will report on all coal utilization research programmes in Australia and advise the Commonwealth and State Governments as to the disposition of additional funds to be made available for such research. It is proposed that in the first year of operation additional funds of about £250,000 will be available for coal utilization research, bringing total expenditure on coal research in Australia to nearly £1 million annually.

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

Research by Private Enterprise. Most large mining and smelting companies have laboratories dealing with their own individual immediate problems. The largest of such laboratories are those of the Broken Hill Proprietary Company Ltd. (the only company with central research facilities separate from production operations and in addition to works laboratories), Broken Hill Associated Smelters Pty. Ltd., and Conzinc Riotinto of Australia Ltd. Private industry has formed the Australian Mineral Industries Research Association which is composed of 43 members which represent a large proportion of the mining, metallurgical and related companies operating in Australia at present. The chief function of the association is to represent private industry in the management of the Australian Mineral Development Laboratories, but the Association also finances other research work into geology, mining and ore-dressing.

The Association recently conducted a survey among its members to obtain details of their research expenditure. The companies surveyed reported their expenditure on research and development, excluding exploration, as £2,364,722 in 1962 and £2,550,113 in 1963. Five of the companies reported their expenditure on research in excess of £100,000 per annum, four between £50,000 and £100,000, five between £10,000 and £50,000, and 29 reported a research budget less than £10,000 per annum.

§ 2. Scope and Sources of Statistics

1. Scope of Statistics.—Statistics presented in this chapter refer mainly to the mining and quarrying industry, which is defined as including all mining and quarrying and the recovery of minerals from ore dumps, tailings, etc. Ore-dressing and elementary smelting of metallic minerals (e.g. in the case of gold) and miscellaneous treatment of non-metallic minerals, where these are carried out in an associated plant at or near the mine, are included in the mining industry. Establishments primarily engaged in smelting and/or refining (including the smelting and refining sections of the large plants operated at Mount Morgan and Mount Isa in Queensland and at Mount Lyell in Tasmania) are excluded from the mining industry and are classified to the manufacturing industry.

However, data relating to mineral treatment activities have been included wherever possible. Thus the information presented in this chapter relates to some extent to the concept of the mineral industry which is generally accepted as including mining and quarrying and the treatment of minerals (e.g. in smelting and refining works).

The coverage of establishments engaged in mining is considered to be satisfactory. However, coverage of establishments engaged in the quarrying of construction materials is incomplete in most States. This deficiency is due primarily to the inherent difficulty of obtaining complete lists of quarries (including those operated by government authorities), many of which operate intermittently and in different locations. There is difficulty also in obtaining satisfactory returns from quarries operated in conjunction with some other activity, e.g. roadmaking, brickworks, etc., and quarries operated in conjunction with large construction projects, such as the Snowy Mountains Scheme, are excluded from these statistics. In some States there have been deficiencies also in the collection of data for certain non-metal (excluding fuel) mining industries, mainly because these are outside the fields normally under the administrative control of Mines Departments. Products chiefly affected are clays, loam and silica.

Statistics presented in this chapter refer mainly to the calendar year 1963, although in some cases data for 1964 are available and have been included. In a few instances it has been necessary to show data on a fiscal year basis, but wherever this occurs it is clearly indicated.

2. Sources of Statistics.—Mining industry data have been obtained annually, since 1952, from the Mining and Quarrying Census. This census is carried out in collaboration with the several Mines Departments and involves the uniform collection of particulars from all establishments employing on the average four or more persons during the period worked by the mine. A representative specimen collection form is included in the bulletin *Non-Rural Primary Industries and Value of Production*, No. 1, 1962-63. For smaller mines either simplified Census returns covering number of persons employed and value of output are collected or these particulars are compiled from data made available by the Mines Departments.

Oil search operations are excluded from the annual Census, but a summary of recent developments in the search for oil, contributed by the Commonwealth Bureau of Mineral Resources, may be found in § 15 of this chapter. Details of the activities of establishments engaged in the mining and treatment of uranium ore have been excluded because of the confidential nature of these operations.

Mineral production statistics contained in this chapter consist, in the main, of official statistics of the Mines Departments of the several States and of the Northern Territory Mines Branch. The particulars shown have been compiled as far as practicable on the standardized basis which has been used in Australia since 1950, and this presentation has involved some rearrangement of official statistics published by the Mines Departments in some States. These statistics have been supplemented, as necessary, by data obtained from the Statisticians of the Several States, the Bureau of Mineral Resources, Geology and Geophysics, the Joint Coal Board, the Division of Minerals of the United States Bureau of Mines, and from several other sources.

Data of imports and exports of minerals and mineral products have been extracted from the official trade statistics compiled in the Commonwealth Bureau of Census and Statistics. Values of Australian overseas trade shown throughout this chapter are expressed as £A. f.o.b. port of shipment, except where otherwise indicated.

§ 3. Mining and Quarrying Industry Statistics

1. **General.**—The mining and quarrying industry is classified into four major groups, namely, metal mining, fuel mining, non-metal mining (excluding fuel), and construction material quarrying.

Mining and quarrying establishments are classified to these groups, and to sub-divisions of these groups, on the basis of the product or products of the establishments. This method of classification is straightforward for those establishments which produce only one product, but for mines and quarries which produce more than one product classification is not as simple a matter. Such establishments are classified according to the most important mineral produced in terms of value. Thus a mine producing, say, both tin and tungsten minerals would be classified as a tin mine if tin were the more important product by value, and as a tungsten mine if tungsten were the dominant product. There is, however, one important exception to this rule in that the mining establishment at Mount Isa is classified to the lead-silver-zinc sector rather than to the copper-gold sector.

For mines and quarries which produce more than one product it is not possible to apportion particulars of operations (such as employment, salaries and wages paid, costs) to the minerals produced. In practice, then, these data are recorded only as a total for each mine, and the mine is classified to an industry sector as outlined above.

Statistics relating to the structure of the industry, employment, production costs and value of additions and replacements to fixed assets are given in the following pages.

2. **Number of Mines and Quarries.**—The following table shows the number of mines and quarries which operated in each State and Territory in 1963.

MINING AND QUARRYING: NUMBER OF MINES AND QUARRIES, 1963

Industry	N.S.W.	Vic.	Q'land	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
Metal mining—									
Gold mining	31	31	34	..	146	4	11	..	257
Lead-silver-zinc mining ..	9	..	1	..	1	2	..	..	13
Copper-gold mining	17	1	44	2	32	1	1	..	98
Tin mining	52	6	190	..	14	24	14	..	300
Mineral sands mining	10	..	4	..	4	..	..	..	18
Other metal mining	20	2	6	2	29	2	1	..	62
Total, Metal Mining	139	40	279	4	226	33	27	..	748
Fuel mining—									
Black coal mining—									
Underground	91	2	69	..	3	(a) 10	..	..	175
Open-cut	3	..	5	1	1	..	..	..	10
Total	94	2	74	1	4	10	..	..	185
Brown coal mining .. ..	..	6	..	..	..	..	..	..	6
Other fuel mining .. ..	..	..	2	..	..	..	..	..	2
Total, Fuel Mining ..	94	8	76	1	4	10	..	..	193
Non-metal (excluding fuel) mining	391	68	103	132	73	24	1	..	792
Total, All Mining ..	624	116	458	137	303	67	28	..	1,733
Construction material quarrying(b)	343	244	52	223	40	55	37	11	1,005
Total, All Mining and Quarrying	967	360	510	360	343	122	65	11	2,738

(a) Includes one mine operating both underground and open-cut workings, owing to difficulties of coverage. See § 2, para. 1. Scope of Statistics, p. 1138.

(b) Incomplete.

In the next table, the numbers of mines and quarries which operated in Australia in each of the years 1959 to 1963 are shown.

MINING AND QUARRYING: NUMBER OF MINES AND QUARRIES, AUSTRALIA

Industry	1959	1960	1961	1962	1963
Metal mining—					
Gold mining	306	296	295	286	257
Lead-silver-zinc mining	35	28	27	22	13
Copper-gold mining	81	90	111	107	98
Tin mining	216	216	266	344	300
Mineral sands mining	22	22	21	20	18
Other metal mining	96	94	85	87	62
<i>Total, Metal Mining</i>	<i>756</i>	<i>746</i>	<i>805</i>	<i>866</i>	<i>748</i>
Fuel mining—					
Black coal mining	218	218	202	198	185
Brown coal mining	8	7	6	6	6
Other fuel mining .. .. .	..	..	..	..	2
<i>Total, Fuel Mining</i>	<i>226</i>	<i>225</i>	<i>208</i>	<i>204</i>	<i>193</i>
Non-metal (excluding fuel) mining(a)	687	698	755	731	792
<i>Total, All Mining</i>	<i>1,669</i>	<i>1,669</i>	<i>1,768</i>	<i>1,801</i>	<i>1,733</i>
Construction material quarrying(a)	862	892	(b)1,056	(b)1,107	(b)1,005
Total, All Mining and Quarrying	2,531	2,561	(b)2,824	(b)2,908	(b)2,738

(a) Incomplete. See § 2, para. 1. Scope of Statistics, p. 1138. prior to 1961, owing to extension of coverage in Victoria.

(b) Not comparable with years

3. **Employment in Mining and Quarrying.**—(i) *Persons Engaged.* Statistics of persons employed in the mining and quarrying industry are derived mainly from the annual census of that industry.

Data on the work force employed in the industry are also obtained from the population censuses of Australia. The population census figure for mining and quarrying includes a number of persons excluded from the mining and quarrying census employment figure, e.g. persons engaged in exploration activities, prospectors, head office employees, etc.

In the following table, which shows particulars collected in the population censuses of Australia at 30th June, 1947, 1954, and 1961, the numbers of persons whose industry statements were classified to "mining and quarrying" are shown together with the numbers engaged in all primary industries and the total work force.

PERSONS ENGAGED IN MINING AND QUARRYING: AUSTRALIA

Particulars	Census, 30th June—		
	1947	1954	1961
Persons engaged in—			
Mining and quarrying	57,574	62,107	54,401
All primary industries	563,697	560,100	513,286
Total work force	3,196,431	3,702,022	4,225,096
Persons engaged in mining and quarrying as a proportion of—			
All primary industries %	10.2	11.1	10.6
Total work force %	1.8	1.7	1.3

NOTE.—An adjustment was made to the 1947 and 1954 industry data by distributing over the range of recorded industry the number of persons whose industry was not stated. No such adjustment was made to the 1961 figures.

The following table is derived from mining census data and shows the average numbers engaged in the various mining industries in each State or Territory in 1963.

MINING AND QUARRYING: EMPLOYMENT(a), 1963

Industry	N.S.W.	Vic.	Q'land	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
Metal mining—									
Gold mining	18	175	121	..	4,833	..	140	..	5,287
Lead-silver-zinc mining	4,347	..	(b)	..	2	(b)	..	..	7,946
Copper-gold mining ..	180	4	(b)	..	184	(b)	244	..	2,288
Tin mining	139	9	387	..	79	474	28	..	1,116
Mineral sands mining ..	1,013	..	(b)	..	(b)	..	..	..	1,565
Other metal mining ..	35	6	95	(b)	522	(b)	1	..	1,168
Total, Metal Mining	5,732	194	4,752	(b)	(b)	2,035	413	..	19,370
Fuel mining—									
Black coal mining—									
Underground	11,398	261	c 2,514	..	(b)	(d) 185	..	..	(b)
Opencut	136	..	206	(b)	(b)	..	..	..	(b)
Total	11,534	261	c 2,720	(b)	(b)	185	..	..	15,636
Brown coal mining ..	..	1,613	..	..	..	..	..	..	1,613
Total, Fuel Mining ..	11,534	1,874	2,720	(b)	(b)	185	..	..	17,249
Non-metal (excluding fuel) mining	1,133	297	284	520	487	102	..	..	2,823
Total, All Mining ..	18,399	2,365	7,756	1,164	7,023	2,322	413	..	39,442
Construction material quarrying(e)	1,844	1,760	418	770	244	270	44	56	5,406
Total, All Mining and Quarrying	20,243	4,125	8,174	1,934	7,267	2,592	457	56	44,848

(a) Average employment during whole year, including working proprietors. (b) Not available for publication. (c) Includes other fuel mining. (d) Includes persons engaged by one mine which has both underground and opencut workings. (e) Incomplete owing to difficulties of coverage. See § 2, para. 1. Scope of Statistics, p. 1138.

The following table shows particulars of mining employment in Australia for the years 1959 to 1963. The figures show the average number of persons employed during the whole year, including working proprietors.

MINING AND QUARRYING: EMPLOYMENT, AUSTRALIA

Industry	1959	1960	1961	1962	1963
Metal mining—					
Gold mining	5,948	5,544	5,438	5,290
Lead-silver-zinc mining	..	9,031	8,731	8,158	7,958
Copper-gold mining	2,301	2,364	2,322	2,242
Tin mining	926	946	1,131	1,157
Mineral sands mining	1,019	1,127	1,141	1,408
Other metal mining	1,031	1,177	1,097	968
Total, Metal Mining	..	20,256	19,889	19,287	19,023
Fuel mining—					
Black coal mining	18,678	18,529	16,957	16,312
Brown coal mining	1,519	1,399	1,441	1,453
Total, Fuel Mining	..	20,197	19,928	18,398	17,765
Non-metal (excluding fuel) mining	2,975	2,925	2,942	2,838
Total, All Mining	..	43,428	42,742	40,627	39,626
Construction material quarrying (b)	4,116	5,016	(c) 5,498	(c) 5,599
Total, All Mining and Quarrying	..	47,544	47,758	c 46,125	c 44,848

(a) Includes other fuel mining. (b) Incomplete, see § 2, para. 1. Scope of Statistics, p. 1138. (c) Not comparable with years prior to 1961, owing to extension of coverage in Victoria.

(ii) *Size Classification of Mines and Quarries.* Most of the mines and quarries worked during 1963 employed less than four persons, including working proprietors. However, more than half of the persons engaged in mining and quarrying were in the 47 mines each employing 200 persons or more. The following table shows the distribution of the total number of mines into various size groups according to the average number of persons employed during the period worked by each mine in 1963.

MINING AND QUARRYING: SIZE CLASSIFICATION OF ESTABLISHMENTS, 1963

Mines and quarries employing on the average(a)—	N.S.W.	Vic.	Q'land	S.A.	W.A.	Tas.	N.T. and A.C.T.	Aust.
Less than 4 persons—								
Establishments ..	690	152	346	262	243	59	60	1,812
Persons ..	1,042	266	573	459	661	190	142	3,333
From 4 to 20 persons—								
Establishments ..	168	180	93	82	72	50	12	657
Persons ..	1,304	1,386	937	642	579	380	97	5,325
From 21 to 200 persons—								
Establishments ..	84	25	69	14	17	10	3	222
Persons ..	6,687	999	(b)	(b)	1,283	599	151	13,717
More than 200 persons—								
Establishments ..	25	3	2	2	11	3	1	47
Persons ..	11,459	1,965	(b)	(b)	5,148	1,684	244	24,818
Total—								
Establishments ..	967	360	510	360	343	122	76	2,738
Persons ..	20,492	4,616	8,609	2,318	7,671	2,853	634	47,193

(a) Average during period worked. Includes working proprietors. (b) Not available for publication; included in total for Australia.

(iii) *Accidents in Mining.* Particulars of numbers of persons killed and injured in accidents in mines and associated treatment plants are recorded by State Mines Departments. Numbers injured are not reported on a uniform basis in all States, as varying criteria are used in determining what constitutes injury. In 1963, 25 persons were recorded as killed and 1,255 as injured in mining (excluding quarrying) accidents. Recorded deaths and injuries in that year were highest in black coal mines (8 and 272, respectively), copper-gold mines (3 and 112), tin mines (3 and 37), gold mines (1 and 345), and silver-lead-zinc mines (1 and 315). Persons killed and injured in the construction material quarrying industry numbered 6 and 56 respectively in 1963.

4. Production Costs in Mining and Quarrying.—(i) Salaries and Wages Paid. Salaries and wages paid in the mining and quarrying industries in Australia during each year 1959 to 1963 are shown in the following table. Information regarding rates of wages paid in the mining industry is shown in Chapter XIII. Labour, Wages and Prices (p. 431) and also in the *Labour Report*.

MINING AND QUARRYING: SALARIES AND WAGES PAID(a), AUSTRALIA
(£'000)

Industry	1959	1960	1961	1962	1963
Metal mining—					
Gold mining	6,504	6,655	6,591	6,534	6,536
Lead-silver-zinc mining	13,944	13,555	13,261	12,227	12,839
Copper-gold mining	2,710	2,938	2,915	2,851	3,100
Tin mining	814	905	946	1,050	1,251
Mineral sands mining	1,188	1,336	1,474	1,739	2,078
Other metal mining	1,058	1,338	1,277	1,188	1,592
<i>Total, Metal Mining</i>	<i>26,218</i>	<i>26,727</i>	<i>26,464</i>	<i>25,589</i>	<i>27,396</i>
Fuel mining—					
Black coal mining	23,437	25,918	25,460	24,849	<i>b</i> 24,615
Brown coal mining	1,710	1,785	1,923	1,971	2,317
<i>Total, Fuel Mining</i>	<i>25,147</i>	<i>27,703</i>	<i>27,383</i>	<i>26,820</i>	<i>26,932</i>
Non-metal (excluding fuel) mining(c)	2,631	2,664	2,875	2,898	2,882
<i>Total, All Mining</i>	<i>53,996</i>	<i>57,094</i>	<i>56,722</i>	<i>55,307</i>	<i>57,210</i>
Construction material quarrying(c)	3,490	3,628	<i>(d)</i> 4,018	<i>(d)</i> 4,381	<i>(d)</i> 4,342
Total, All Mining and Quarrying	57,486	60,722	<i>d</i> 60,740	<i>d</i> 59,688	<i>d</i> 61,552

(a) Excludes mines and quarries employing less than four persons, and drawings by working proprietors; the amounts are net after deducting value of explosives sold to employees. (b) Includes other fuel mining. (c) Incomplete. See § 2, para. 1. Scope of Statistics, p. 1138. (d) Not comparable with years prior to 1961, owing to extension of coverage in Victoria.

(ii) *Power, Fuel, Light and Materials, etc., used.* The following table contains details of the value of power, fuel, materials and stores used by the mining and quarrying industry during each year 1959 to 1963.

MINING AND QUARRYING: VALUE OF POWER, FUEL, LIGHT AND MATERIALS, ETC., USED, AUSTRALIA
(£'000)

Industry	1959	1960	1961	1962	1963
Metal mining—					
Gold mining	5,069	4,909	4,979	4,947	4,879
Lead-silver-zinc mining	10,367	12,106	10,303	8,671	10,795
Copper-gold mining	3,325	3,288	3,503	3,384	3,616
Tin mining	512	530	601	637	754
Mineral sands mining	1,348	1,562	1,797	1,838	2,526
Other metal mining	924	1,109	1,258	1,242	1,425
<i>Total, Metal Mining</i>	<i>21,545</i>	<i>23,504</i>	<i>22,441</i>	<i>20,719</i>	<i>23,995</i>
Fuel mining—					
Black coal mining	10,166	11,319	12,409	13,346	<i>a</i> 13,501
Brown coal mining	593	623	622	672	739
<i>Total, Fuel Mining</i>	<i>10,759</i>	<i>11,942</i>	<i>13,031</i>	<i>14,018</i>	<i>14,240</i>
Non-metal (excluding fuel) mining(b)	2,359	2,340	2,508	2,818	2,767
<i>Total, All Mining</i>	<i>34,663</i>	<i>37,780</i>	<i>37,980</i>	<i>37,555</i>	<i>41,002</i>
Construction material quarrying(b)	4,167	4,427	<i>(c)</i> 4,926	<i>(c)</i> 4,500	<i>(c)</i> 4,541
Total, All Mining and Quarrying	38,830	42,213	<i>(c)</i> 42,906	<i>c</i> 42,055	<i>c</i> 45,543

(a) Includes other fuel mining. (b) Incomplete. See § 2, para. 1. Scope of Statistics, p. 1138. (c) Not comparable with years prior to 1961, owing to extension of coverage in Victoria.

5. Value of Additions and Replacements to Fixed Assets in Mining and Quarrying.—The following table shows details for Australia of the value of additions and replacements to fixed assets during the years 1959 to 1963.

MINING AND QUARRYING: VALUE OF ADDITIONS AND REPLACEMENTS TO FIXED ASSETS^(a), AUSTRALIA

(£'000)

Industry	1959	1960	1961	1962	1963
Metal mining—					
Gold mining	1,446	789	778	1,608	1,012
Lead-silver-zinc mining	6,566	3,548	3,425	3,523	7,077
Copper-gold mining	651	451	845	1,365	2,533
Tin mining	66	185	261	270	774
Mineral sands mining	787	481	728	1,876	1,218
Other metal mining	713	1,369	1,138	2,577	3,442
<i>Total, Metal Mining</i>	<i>10,229</i>	<i>6,823</i>	<i>7,175</i>	<i>11,219</i>	<i>16,056</i>
Fuel mining—					
Black coal mining	7,707	10,947	11,535	13,048	<i>b</i> 10,334
Brown coal mining	3,654	1,914	2,723	3,061	3,305
<i>Total, Fuel Mining</i>	<i>11,361</i>	<i>12,861</i>	<i>14,258</i>	<i>16,109</i>	<i>13,639</i>
Non-metal (excluding fuel) mining ^(c)	1,454	588	1,274	704	871
<i>Total, All Mining</i>	<i>23,044</i>	<i>20,272</i>	<i>22,707</i>	<i>28,032</i>	<i>30,566</i>
Construction material quarrying ^(c)	1,408	1,624	2,281	1,951	1,949
<i>Total, All Mining and Quarrying</i>	<i>24,452</i>	<i>21,896</i>	<i>24,988</i>	<i>29,983</i>	<i>32,515</i>

(a) Excludes mines and quarries employing less than four persons.
 (c) Incomplete. See § 2, para. 1. Scope of Statistics, p. 1138.

(b) Includes other fuel

6. Value of Production.—Particulars of the local value of production (ex-mine value of output) for individual mining industry groups and quarrying are shown on pages 1185.

§ 4. Mining and Quarrying Commodity Statistics

1. General.—In the preparation of Australian mineral commodity production statistics the quantities and values of individual minerals produced are recorded in terms of the products in the form in which they are dispatched from the locality of each mine. For example, in the case of a metal mine, the output is recorded as ore when no treatment is undertaken at the mine, or as a concentrate where ore-dressing operations are carried out in associated works in the locality of the mine. In addition to the basic quantity data, the contents of metallic minerals and contents or average grade of selected non-metallic minerals are recorded. Whenever practicable, contents (based on assay) of metallic minerals are shown for each metal which is a "pay metal" or a "refiners' prize" when present in the particular mineral. In general, other metallic contents which are not recovered are excluded.

Minerals are divided into four major groups, namely, metals, fuels, non-metals (excluding fuels) and construction materials. In this chapter individual mineral products are arranged in these four groups. Particulars relating to uranium-bearing minerals are excluded.

2. Quantity of Principal Minerals Produced.—In the following table particulars of the quantity of the principal minerals produced during 1963 are shown for each State and the Northern Territory.

QUANTITIES OF PRINCIPAL MINERALS PRODUCED, 1963

Mineral	N.S.W.	Vic.	Q'land	S.A.	W.A.	Tas.	N.T.	Aust.
METALLIC MINERALS								
Antimony ore and concentrate tons	115							115
Bauxite "	7,352	2,157	287,491		57,206			354,206
Beryllium ore "	13			15	82			110
Copper ore(a) "		72	68,309			10,394		78,775
Copper concentrate "		11	343,373		6,266	55,405	29,313	434,368
Copper precipitate "	152		330			22		504
Gold(b) oz.	394	27,660	36,095	18	110,454	181	61,723	123,061
Ilmenite concentrate tons	5,975				195,008			200,983
Iron ore(c) '000 tons				4,182	1,333			5,515
Lead ore(d) tons	1,573		14,676					16,249
Lead concentrate "	429,944		138,012		185	16,321		584,462
Lead-copper concentrate "						9,309		9,309
Manganese ore "	624		150		34,808		479	36,061
Pyrite concentrate "			33,054	83,070	58,472	19,463		194,059
Rutile concentrate "	135,149		47,348		763			183,260
Tantalite-columbite concentrate lb.					30,889			30,889
Tin concentrate tons	352	15	1,692		576	1,435	62	4,132
Tungsten concentrates—								
Scheelite concentrate "						958		958
Wolfram concentrate "						394		394
Zinc concentrate "	465,158		48,535			81,168		594,861
Zircon concentrate "	119,586		52,720		12,524			184,830
FUEL MINERALS								
Coal, black—								
Semi-anthracite '000 tons			59			2		61
Bituminous "	18,940	51	3,072			205		22,268
Sub-bituminous "			113	1,512	902			2,527
Total "	18,940	51	3,244	1,512	902	207		24,856
Coal, brown (lignite) " 18,456								
Natural gas '000 c. ft.			95,725					95,725
Condensate gals.			4,312					4,312
NON-METALLIC (EXCLUDING FUEL) MINERALS								
Asbestos short tons	938				12,436			13,374
Barite tons	1,540			6,680				8,220
Clays—								
Brick clay and shale '000 tons	1,987	1,346	223	407	439	147		4,549
Other(e) "	505	204	105	82	62	26		984
Diatomite tons	2,837	496	1,800					5,133
Dolomite(f) "	4,481		6,391	200,844		2,623		214,339
Felspar "	6,690			1,160	992			8,842
Gypsum "	62,247	114,503		497,886	50,808			725,444
Limestone(f) '000 tons	2,542	1,228	(g)	1,574	(g)	345		6,721
Magnesite tons	49,909			342	6,495			56,946
Phosphate rock "				4,909	16			4,925
Salt, crude "		(g)	(g)	459,005	(g)			581,537
Silica (glass, chemical, etc.) "	161,709		38,111	24,879	20,388	2,641		247,928
Talc "	1,184		10	7,243	4,669			13,106
CONSTRUCTION MATERIALS(e)								
Sand '000 tons	3,671	3,000	n.a.	1,994	n.a.	110 (h)	275	9,050
River gravel "	1,853	3,684	n.a.	1,049	n.a.	914 (h)	124	7,624
Dimension stone "	371	10	2	25	211	2 (h)	8	629
Crushed and broken stone "	3,809	12,384	2,533	8,361	1,537	923 (h)	221	29,768
Other (decomposed rock, etc.) "	18,233	2,497	n.a.	n.a.	n.a.	20 (h)	80	20,830

(a) Includes cupreous ore for fertilizer. (b) Bullion, alluvial, retorted gold, etc. (c) Iron oxide for metal extraction only. (d) Includes lead-silver-zinc ore. (e) Incomplete, see § 2, para. 1. Scope of Statistics, p. 1138. (f) Excludes quantities used directly as building or road material. (g) Not available for publication. (h) Includes Australian Capital Territory which is not available for separate publication.

The following table shows the quantities of the principal minerals produced in Australia during the years 1959 to 1963.

QUANTITIES OF PRINCIPAL MINERALS PRODUCED: AUSTRALIA

Mineral	1959	1960	1961	1962	1963
METALLIC MINERALS					
Antimony ore and concentrate .. tons	1,022	256	190	100	115
Bauxite "	14,985	69,435	15,976	29,547	354,206
Beryllium ore "	317	190	306	223	110
Chromite "	120	529	..	369	160
Copper ore(a) "	77,738	68,321	75,215	110,777	78,775
Copper concentrate "	358,774	432,758	373,770	395,427	434,368
Copper precipitate "	1,379	1,301	825	216	504
Gold concentrate "	1,487	43	1	..	..
Gold—other forms(b) .. '000 oz.	(c)	(c)	(c)	(c)	1,231
Ilmenite concentrate tons	83,577	106,586	166,400	179,494	200,983
Iron ore(d) '000 tons	4,141	4,355	5,342	4,843	5,515
Lead ore(e) tons	12,693	13,716	7,743	13,197	16,249
Lead concentrate "	461,055	449,590	382,292	522,276	584,462
Lead-copper concentrate "	6,010	6,797	8,057	11,192	9,309
Manganese ore "	89,971	60,646	87,411	71,646	36,061
Pyrite concentrate "	223,004	238,630	213,423	148,566	194,059
Rutile concentrate "	81,905	88,637	101,431	119,195	183,260
Tantalite-columbite concentrate .. lb.	18,950	23,677	31,808	43,097	30,889
Tin concentrate tons	3,304	3,099	3,870	3,842	4,132
Tungsten concentrates—					
Scheelite concentrate "	1	420	1,017	995	958
Wolfram concentrate "	903	1,131	1,142	492	394
Zinc concentrate "	473,276	549,000	542,640	572,900	594,861
Zircon concentrate "	113,356	102,362	136,462	133,844	184,830

FUEL MINERALS

Coal, black—					
Semi-anthracite '000 tons	54	50	59	70	61
Bituminous "	18,576	20,641	21,991	22,006	22,268
Sub-bituminous "	1,668	1,878	1,956	2,394	2,527
<i>Total</i> "	20,298	22,569	24,006	24,470	24,856
Coal, brown (lignite) "					
Natural gas '000 c. ft.	..	..	12,187	56,361	95,725
Condensate gals.	..	..	559	2,199	4,312

NON-METALLIC (EXCLUDING FUEL) MINERALS

Asbestos short tons	17,875	15,613	16,746	18,416	13,374
Barite tons	6,214	11,417	19,217	12,534	8,220
Clays—					
Brick clay and shale '000 tons	4,299	4,636	4,344	4,383	4,549
Other "	823	880	912	913	984
Diatomite tons	5,089	4,659	5,417	7,312	5,133
Dolomite(f) "	160,084	190,868	191,624	180,697	214,339
Felspar "	6,750	8,414	8,209	8,513	8,842
Gypsum "	516,791	580,878	609,907	630,910	725,444
Limestone(f) '000 tons	5,305	5,669	6,146	6,415	6,721
Magnesite tons	60,586	62,166	98,795	62,191	56,946
Mica—muscovite, trimmed .. lb.	44,665	9,500	..	..	..
Phosphate rock tons	4,775	2,321	4,874	4,385	4,925
Salt, crude "	467,532	463,296	508,657	536,019	581,537
Silica (glass, chemical, etc.) .. "	154,778	210,100	212,575	218,544	247,928
Talc "	16,376	15,670	13,545	14,060	13,106

NOTE.—For footnotes see next page.

QUANTITIES OF PRINCIPAL MINERALS PRODUCED: AUSTRALIA—*continued*

Mineral	1959	1960	1961	1962	1963
CONSTRUCTION MATERIALS(g)					
Sand '000 tons	4,623	5,934	7,427	7,535	9,050
River gravel "	2,524	2,932	6,018	5,912	7,624
Dimension stone "	283	318	533	379	629
Crushed and broken stone "	19,822	22,530	27,303	27,944	29,768
Other (decomposed rock, etc.) "	13,699	15,586	16,482	17,310	20,830

(a) Includes cupreous ore for fertilizer. (b) Bullion, alluvial, retorted gold, etc. (c) Gross weight not available. (d) Iron oxide for metal extraction. (e) Includes lead-silver-zinc ore. (f) Excludes quantities used directly as building or road material. (g) Incomplete owing to difficulties of coverage. See § 2, para. 1. Scope of Statistics, p. 1138. 1961 and later figures are not comparable with previous years owing to extension of coverage in Victoria.

NOTE.—Particulars of production of uranium oxide (U_3O_8) are not available for publication.

3. Contents of Metallic Minerals Produced.—The following table shows the contents of metallic minerals produced in 1963 which were "pay metals" or which were recovered as "refiners' prizes". Further particulars for earlier years are shown in the following paragraph and in the sections later in this chapter covering principal contents.

CONTENTS OF METALLIC MINERALS PRODUCED, 1963

Content of metallic minerals produced	N.S.W.	Vic.	Q'land	S. Aust.	W. Aust.	Tas.	N.T.	Aust.
Alumina (Al_2O_3) tons	2,801	1,161	129,371	..	21,166	..	..	154,499
Antimony .. "	74	..	..	..	..	..	..	74
Beryllium oxide (BeO) unit(a)	159	..	..	195	924	..	..	1,278
Cadmium .. tons	1,035	..	..	..	..	74	..	1,109
Chromic oxide (Cr_2O_3) .. tons	..	..	72	..	..	..	..	72
Cobalt .. "	86	..	..	..	..	..	..	86
Copper .. "	3,864	6	83,221	5	1,919	16,805	7,147	112,967
Gold .. fine oz.	11,395	24,668	68,586	16	802,860	36,422	80,023	1,023,970
Iron(b) .. '000 tons	..	..	..	2,718	840	..	..	3,558
Lead .. tons	328,462	..	66,711	..	136	14,982	..	410,291
Manganese(c) .. "	..	..	..	..	23,951	..	..	23,951
Manganese dioxide (MnO_2)(d) .. tons	467	..	114	..	527	..	120	1,228
Molybdenum disulphide (MoS_2) .. lb.	..	..	32,547	..	..	..	..	32,547
Monazite .. tons	471	..	179	..	1,225	..	..	1,875
Platinum .. oz.	4	..	..	..	..	..	..	4
Silver .. '000 fine oz.	11,425	1	6,202	..	221	1,702	91	19,642
Sulphur(e) .. tons	212,712	..	32,541	32,813	25,252	42,318	..	345,636
Tantalite columbite ($Ta_2O_5 + Nb_2O_5$) .. lb.	..	..	..	..	12,935	..	..	12,935
Tin .. tons	250	11	1,196	..	363	1,005	35	2,860
Titanium dioxide (TiO_2) .. tons	132,620	..	45,454	..	109,976	..	..	288,050
Tungstic oxide (WO_3) .. tons	..	..	..	..	..	960	..	960
Zinc .. "	265,637	..	37,344	..	..	48,489	..	351,470
Zircon .. "	117,520	..	52,193	..	12,399	..	..	182,112

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

NOTE.—Particulars of production of uranium oxide (U_3O_8) are not available for publication.

Particulars of the contents of metallic minerals produced in Australia in the years 1959 to 1963 are shown in the following table. Graphs showing details of the mine production of principal metals and coal from 1935 to 1964 may be found on pages 1155-6.

CONTENTS OF METALLIC MINERALS PRODUCED: AUSTRALIA

Content of metallic minerals produced	1959	1960	1961	1962	1963
Alumina (Al ₂ O ₃) .. tons	6,914	31,393	7,464	13,250	154,499
Antimony .. "	1,280	786	680	874	74
Beryllium oxide (BeO) units(a)	3,587	2,221	3,585	2,586	1,278
Bismuth .. lb.	..	..	602	97	..
Cadmium .. tons	860	949	907	992	1,109
Chromic oxide (Cr ₂ O ₃) .. "	60	265	..	185	72
Cobalt .. "	60	65	65	78	86
Copper .. "	94,950	109,435	95,626	106,972	112,967
Gold .. fine oz.	1,085,104	1,086,709	1,076,292	1,068,837	1,023,970
Iron(b) .. '000 tons	2,700	2,814	3,434	3,119	3,558
Lead .. tons	316,293	308,163	269,656	370,110	410,291
Manganese(c) .. "	46,729	33,964	45,087	39,413	23,951
Manganese dioxide (MnO ₂)(d)	..	..	..	..	..
.. tons	2,534	2,058	1,429	1,512	1,228
Molybdenum disulphide (MoS ₂) .. lb.	..	..	2,630	2,332	32,547
Monazite .. tons	331	344	1,463	772	1,875
Osmiridium .. oz.	3	..	..	..	..
Platinum .. "	..	4	2	2	4
Silver .. '000 fine oz.	15,161	15,216	13,059	17,554	19,642
Sulphur(e) .. tons	310,545	340,000	324,866	312,803	345,636
Tantalite-columbite (Ta ₂ O ₅ +Nb ₂ O ₅) .. lb.	8,499	11,500	13,814	18,879	12,935
Tin .. tons	2,351	2,202	2,745	2,715	2,860
Titanium dioxide (TiO ₂) .. "	125,523	144,742	191,965	215,494	288,050
Tungstic oxide (WO ₃) .. "	653	1,111	1,536	1,042	960
Zinc .. "	275,411	317,489	311,157	337,532	351,470
Zircon .. "	112,352	101,494	134,483	132,109	182,112

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

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

4. Value of Minerals Produced.—Particulars of the values of minerals (mine and quarry products) produced are shown on pages 1184-8.

§ 5. Gold

1. Historical.—A brief history of gold-mining in Australia may be found in previous issues of the Year Book (see No. 48, p. 1059).

2. Methods of Mining and Treatment.—Nearly all gold-bearing ore produced in Australia is won by underground mining of veins or lodes. Gold won from alluvial deposits is almost negligible and is, in part, a by-product of alluvial tin mining. A high recovery of gold can be made from most gold ores by amalgamation, amalgamation followed by cyanidation, or by cyanidation only. The Kalgoorlie mines, the largest producers of gold in Australia, find it necessary, in addition to cyanidating the whole of the ore, to make a flotation concentrate of the sulphide and telluride minerals which are then roasted and cyanided separately. Gold, whether recovered by amalgamation, cyanidation or flotation is always smelted into the form of bullion before sale.

3. **Mine Production.**—The following table shows the mine production of gold (gold content of minerals produced) during 1963 according to the mineral in which it was contained and the State or Territory of origin.

GOLD: MINE PRODUCTION, 1963

(fine oz.)

Mineral in which contained	N.S.W.	Vic.	Q'land	S.A.	W.A.	Tas.	N.T.	Aust.
Copper ore, concentrate, etc. ..	..	..	53,369	..	4,310	10,305	23,758	91,742
Gold bullion(a) ..	321	24,668	15,217	16	798,550	165	56,265	895,202
Lead concentrate ..	9,485	..	..	..	..	4,335	..	13,820
Lead-copper concentrate ..	..	..	..	..	..	18,820	..	18,820
Zinc concentrate ..	1,589	..	..	..	..	2,797	..	4,386
Total Gold ..	11,395	24,668	68,586	16	802,860	36,422	80,023	1,023,970

(a) Retorted gold, alluvial gold, etc.

The principal sources of production during 1963 were as follows.

Western Australia. More than half the total production came from the East Coolgardie goldfield, while most of the remaining production came from the Dundas, Murchison and Yilgarn goldfields. Total production was 802,860 fine ounces, which was 57,179 fine ounces less than production in 1962. The Yilgarn, Coolgardie, East Murchison and Pilbara fields recorded lower production.

Northern Territory. Gold production is centred on Tennant Creek.

Queensland. The copper concentrate produced at Mount Morgan contained more than three-quarters of the State's output of gold, nearly all the remaining production coming from a mine at Cracow.

The following table shows the recorded mine production of gold (i.e. gold content of minerals produced) in the several States and in Australia as a whole during each year 1960 to 1964 and total output since the first major discovery of gold in 1851. Owing to defective information in the earlier years, it is likely that the total production figures fall considerably short of the actual totals.

GOLD: MINE PRODUCTION(a)

State or Territory	1960	1961	1962	1963	1964(b)	Total(b) 1851-1964
	f. oz.	f. oz.	f. oz.	f. oz.	f. oz.	
New South Wales ..	13,628	12,034	11,234	11,395	10,569	16,495
Victoria ..	28,566	26,229	28,262	24,668	21,270	73,779
Queensland ..	78,267	64,786	67,729	68,586	101,010	22,990
South Australia ..	36	55	48	16	17	451
Western Australia ..	869,966	870,658	860,039	802,860	715,481	64,874
Tasmania ..	23,994	26,885	32,115	36,422	35,083	2,531
Northern Territory ..	72,252	75,645	69,410	80,023	82,317	1,690
Australia ..	1,086,709	1,076,292	1,068,837	1,023,970	965,747	182,810

(a) Gold content of minerals produced.

(b) Subject to revision.

4. **Refinery Production.**—Amalgam and gold slimes from cyanide extraction are treated at the mines to produce gold bullion, which at some mines may be partly refined before dispatch to the refineries (the largest refinery is the Royal Mint, Perth). By-product gold from lead smelting is refined at Port Pirie in South Australia, while the gold contained in copper refinery sludges resulting from electrolytic copper refining at Mount Lyell and Port Kembla is recovered at Port Kembla. Gold bullion and other gold-bearing materials are also refined in Sydney and Melbourne.

Details of the refinery production of gold in Australia and the value of refined newly-won gold of Australian origin are shown in the following table for each of the years 1960 to 1964. The value of the refined newly-won gold is based on the price fixed by the Reserve Bank, but allowance is made for premiums on sales of gold overseas and for industrial purposes in Australia.

PRODUCTION OF REFINED GOLD IN AUSTRALIA

Particulars	1960	1961	1962	1963	1964
QUANTITY (FINE OZ.)					
Australian origin—					
Newly-won gold	1,045,139	1,036,947	1,024,623	958,381	892,726
From scrap	22,699	22,593	21,806	20,404	19,282
Oversea origin—					
Newly-won gold	142,526	155,598	138,455	161,083	140,557
From scrap	1,164	1,277	188	290	901
Total	1,211,528	1,216,415	1,185,072	1,140,158	1,053,466
VALUE (£'000) (a)					
<i>Newly-won gold of Australian origin</i>	16,396	16,241	16,021	14,997	13,998

(a) Based on the price fixed by the Reserve Bank. Includes allowance for premiums on sales of gold overseas and for industrial purposes in Australia.

5. **Changes in Stocks of Gold held in Australia.**—The following table shows particulars of production and consumption, imports and exports of gold and changes in stocks of gold held in Australia for each of the years 1960 to 1964.

CHANGES IN STOCKS OF GOLD HELD IN AUSTRALIA
(fine oz.)

Particulars	1960	1961	1962	1963	1964 (a)
Supplies—					
Mine production of gold(b)	1,086,709	1,076,292	1,068,837	1,023,970	965,747
Imports of gold(c)(d) ..	144,033	146,279	132,963	162,065	144,307
<i>Total Supplies</i> ..	<i>1,230,742</i>	<i>1,222,571</i>	<i>1,201,800</i>	<i>1,186,035</i>	<i>1,110,054</i>
Disposals—					
Exports of gold(c) ..	2,513,906	1,099,701	314,996	472,132	427,203
Gold content of ores and concentrates exported ..	25,803	39,835	44,166	50,683	49,848
Gold exported in unrefined bullion .. ..	..	..	..	..	719
Net industrial consumption of gold	40,972	35,429	47,881	61,042	77,580
<i>Total Disposals</i> ..	<i>2,580,681</i>	<i>1,174,965</i>	<i>407,043</i>	<i>583,857</i>	<i>555,350</i>
Changes in stocks of gold held in Australia(e)	-1,349,939	+ 47,606	+ 794,757	+ 602,178	+ 554,704

(a) Subject to revision. (b) Gold content of minerals produced in Australia. (c) Excludes specie, leaf and foil and gold in unrefined forms other than the gold content of unrefined gold and silver bullion. (d) Excludes gold imported in some minor minerals. (e) Includes changes in holdings in Australia by official and banking institutions both on their own behalf and that of non-residents, together with the gold content of changes in stocks of minerals awaiting refining. The sign near the figure indicates increase (+) or decrease (-) in stocks during the period shown.

6. **Prices of Gold.**—Under existing legislation all gold produced in Australia is sold to the Reserve Bank. The official price of gold is fixed by the Reserve Bank. On 1st May, 1954, it was raised from £15 9s. 10d. to £15 12s. 6d. per fine oz. and has remained unchanged since that date. The current price reflects the "parity" value of Australian currency established by the *International Monetary Agreement Act 1947*. Prior to 1947 the price of gold was based on the price for which it could be sold abroad in official markets, less cost of movement.

Average prices of gold per fine oz. at mints in Australia and on the London gold market are shown in the following table for the years 1960 to 1964.

PRICES OF GOLD: AUSTRALIA AND LONDON
(per fine oz.)

Place of sale	1960	1961	1962	1963	1964
At mints in Australia £A. s. d.	15 12 6	15 12 6	15 12 6	15 12 6	15 12 6
London £stg. s. d.	12 11 2½	12 11 0	12 10 1	12 10 6½	12 11 3½

7. **Sales of Gold on Oversea Premium Markets.**—In November, 1951, the Commonwealth Government decided to allow Australian gold producers to benefit from the higher prices then being paid for gold on some overseas markets. To implement this decision producers formed the Gold Producers' Association Limited in December, 1951, and the first sales were made in that month. By arrangement with the Reserve Bank of Australia the total quantity of newly-won gold delivered to the Bank by members of the Association in any calendar month, less the quantity required for industrial purposes in Australia, is available to the Association for sale on overseas premium markets during the ensuing two calendar months. The net proceeds from premium sales are distributed to members in proportion to their production of gold.

The following table shows the quantity and value of gold sold on oversea premium markets and the average price realized for these sales during the years 1960 to 1964.

GOLD SOLD ON OVERSEA PREMIUM MARKETS

Particulars	1960	1961	1962	1963	1964
Quantity fine oz.	320,151	733,217	320,323	512,805	448,310
Value £A.	5,049,183	11,513,571	5,016,625	8,028,227	7,038,619
Average price £A. s. d.	15 15 5	15 14 0½	15 13 2½	15 13 1½	15 14 0

8. *Gold Subsidy*.—Details of amounts paid under the provisions of the *Gold-Mining Industry Assistance Act 1954-1962* for the years 1960 to 1964 are shown in the following table. Particulars of this Act and other legislation are given on page 1134.

NET SUBSIDY PAYMENTS TO GOLD PRODUCERS

(£A.)

Year	New South Wales	Vic.	Q'land	S. Aust.	W. Aust.	Tas.	Nor. Terr.	Papua and New Guinea	Total
1960	14	45,881	881	35	698,242	..	4,253	65,292	814,598
1961	145	63,036	1,325	..	585,306	..	4,930	44,758	699,500
1962	61	50,579	2,134	97	621,573	18	1,235	72,812	748,509
1963	463	43,267	2,488	..	669,782	12	288	42,896	759,196
1964	395	38,512	1,340	..	541,687	..	847	47,989	630,770

9. *Production in Principal Countries*.—The quantities of gold produced in the five principal producing countries and the estimated world total production in each of the years 1959 to 1963 are shown in the following table.

GOLD: MINE PRODUCTION IN SELECTED COUNTRIES

(Source: *Minerals Yearbook*, United States Department of the Interior)

('000 fine oz.)

Country	1959	1960	1961	1962	1963
South Africa	20,066	21,383	22,942	25,492	27,432
U.S.S.R.(a)	10,000	11,000	11,800	12,200	12,500
Canada	4,483	4,629	4,474	4,178	4,011
United States of America	1,603	1,667	1,548	1,543	1,454
Australia	1,085	1,087	1,076	1,069	1,024
<i>World Total(a)</i>	42,600	45,100	47,200	49,800	51,700

(a) Estimated.

§ 6. Lead, Silver and Zinc

1. **Historical.**—A brief history of silver-lead-zinc mining in Australia may be found in previous issues of the Year Book (*see* No. 48, p. 1065).

2. **Methods of Mining and Treatment.**—All the lead-zinc production from the large mines is obtained by underground mining. The lead-zinc sulphides mined are concentrated by differential flotation to produce separate lead and zinc concentrates, the lead concentrates containing most of the silver originally present in the ore.

3. **Mine Production.**—The following table shows the mine production for 1963 (metal content of ores and concentrates produced) of lead, silver and zinc in Australia, and the respective minerals in which these metals were contained.

LEAD, SILVER AND ZINC: CONTENT OF ORES AND CONCENTRATES PRODUCED, 1963

Mineral in which contained	N.S.W.	Vic.	Q'land	S.A.	W. Aust.	Tas.	N.T.	Aust.
LEAD (tons)								
Lead ore ..	180	..	866	..	..	..	..	1,046
Lead concentrate ..	324,461	..	64,728	..	136	9,557	..	398,882
Lead-copper concentrate ..	..	..	..	..	..	2,934	..	2,934
Zinc concentrate ..	3,821	..	1,117	..	..	2,491	..	7,429
Total Lead ..	328,462	..	66,711	..	136	14,982	..	410,291
SILVER (fine oz.)								
Copper ore ..	..	..	..	..	..	9,023	..	9,023
Copper concentrate ..	..	..	738,610	..	12,436	59,608	90,956	901,610
Copper precipitate ..	..	..	..	..	..	3	..	3
Gold concentrate, etc.	33	546	14,777	..	208,328	..	..	223,684
Lead ore ..	27,131	..	29,152	..	..	..	..	56,283
Lead concentrate ..	11,058,747	..	5,258,257	..	90	461,396	..	16,778,490
Lead-copper concentrate ..	..	..	..	..	..	941,668	..	941,668
Zinc concentrate ..	338,947	..	161,263	..	..	230,954	..	731,164
Total Silver ..	11,424,858	546	6,202,059	..	220,854	1,702,652	90,956	19,641,925
ZINC (tons)								
Lead concentrate ..	18,530	..	12,145	..	..	2,537	..	33,212
Lead-copper concentrate ..	..	..	..	..	..	1,081	..	1,081
Zinc concentrate ..	247,107	..	25,199	..	..	44,871	..	317,177
Total Zinc ..	265,637	..	37,344	..	..	48,489	..	351,470

The principal sources of production of lead, silver and zinc during 1963, were as follows.

New South Wales. Lead and zinc concentrates, produced at Broken Hill, contained nearly all the New South Wales production of lead, silver and zinc. During 1963 New South Wales mines produced (in terms of the content of all ores and concentrates produced) 80 per cent. of Australia's lead, 76 per cent. of the zinc and 58 per cent. of the silver.

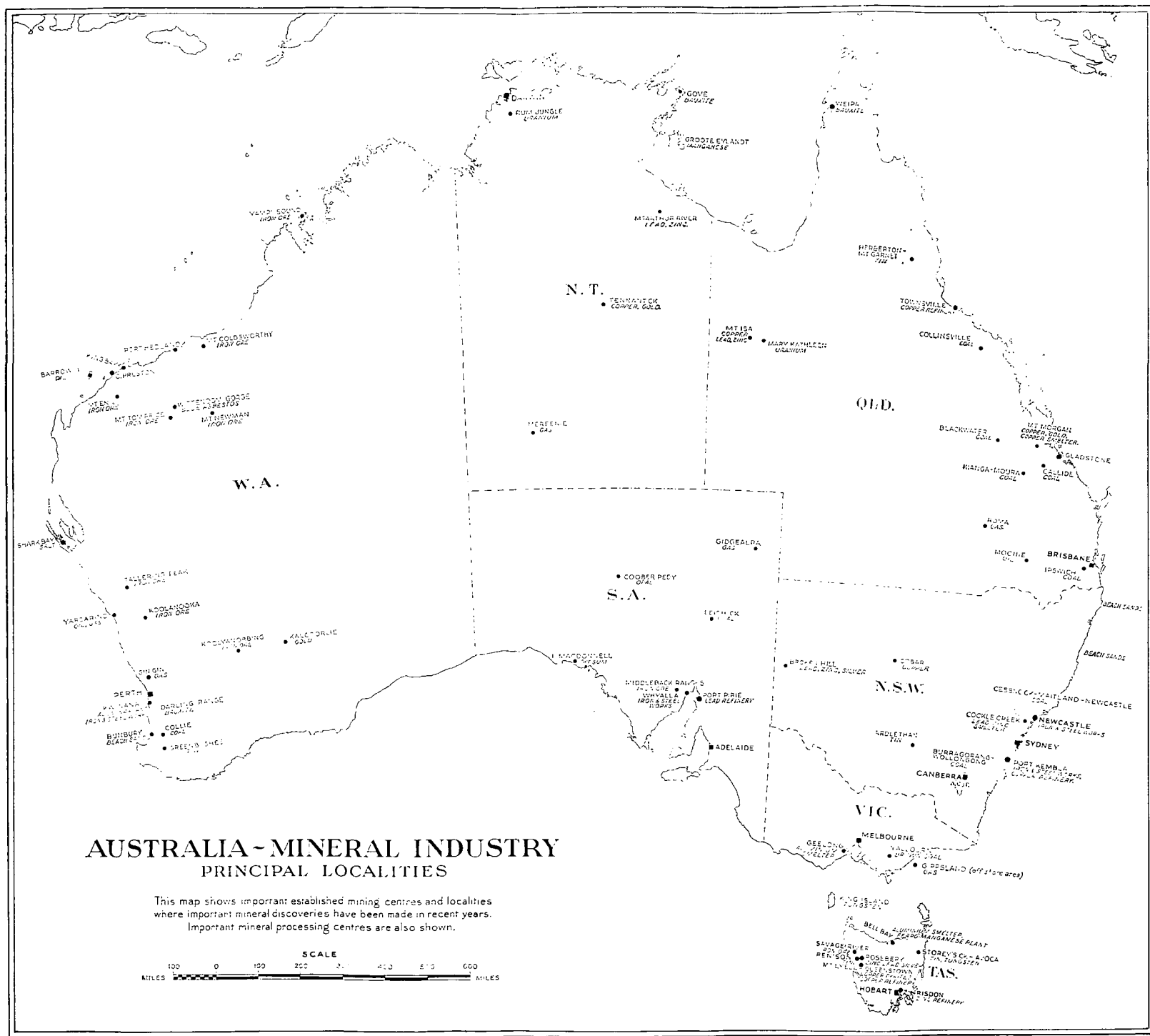
Queensland. Mount Isa produced all the lead and zinc concentrates in Queensland during 1963. These concentrates contained almost all the State's production of lead and silver and all the zinc. Nearly all the remaining silver was contained in copper concentrates produced at Mount Isa and at Mount Morgan.

Tasmania. All the lead, silver and zinc was produced from mines on the west coast. All the zinc and most of the lead and silver were produced from mines at Rosebery and Williamsford and milled at Rosebery to produce separate lead, zinc, and lead-copper concentrates.

The table hereunder shows the quantities of lead, silver and zinc contained in minerals won in the several States and the Northern Territory during the years 1959 to 1963.

LEAD, SILVER AND ZINC: CONTENT OF ORES AND CONCENTRATES PRODUCED

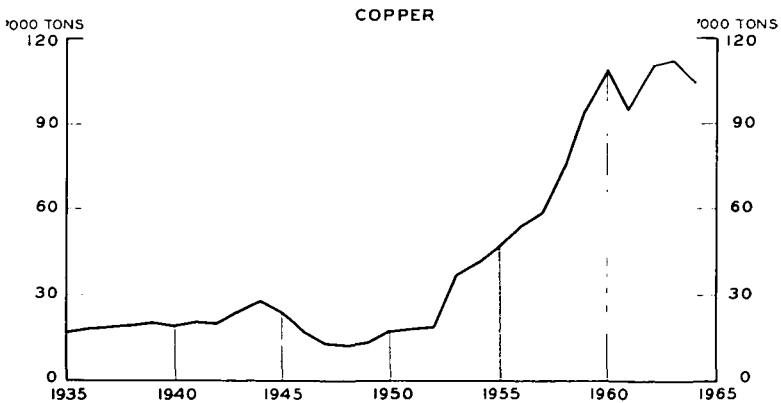
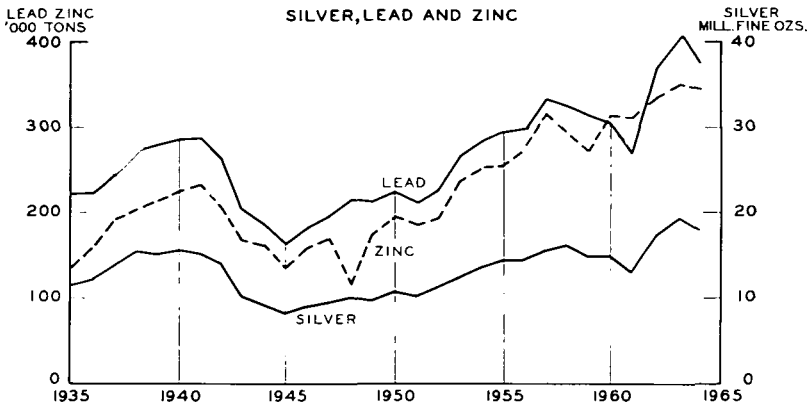
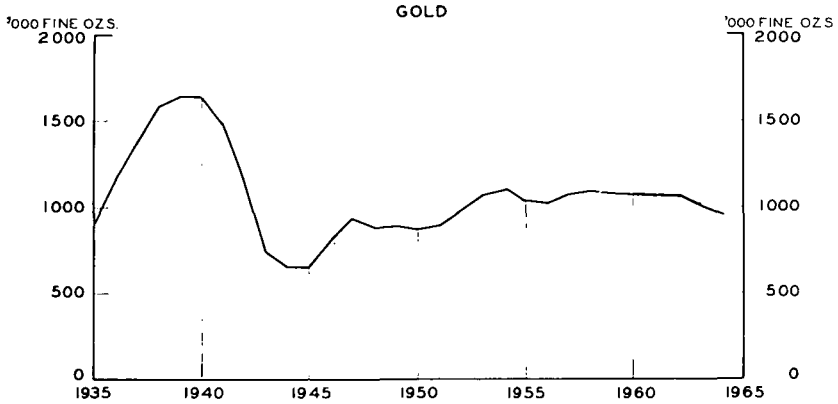
State or Territory	1959	1960	1961	1962	1963
LEAD (tons)					
New South Wales	246,449	235,868	211,679	292,381	328,462
Queensland	54,415	57,518	45,280	62,669	66,711
South Australia	8	..	..	..	..
Western Australia	1,382	1,739	433	306	136
Tasmania	14,039	13,038	12,253	14,754	14,982
Northern Territory .. ..	..	..	11	..	..
Australia	316,293	308,163	269,656	370,110	410,291
SILVER (fine oz.)					
New South Wales	8,555,203	8,397,889	7,447,957	9,929,179	11,424,858
Victoria	2,016	576	573	472	546
Queensland	4,953,209	5,121,700	3,882,784	5,600,502	6,202,059
South Australia	394	..	..	..	..
Western Australia	179,601	196,756	209,647	218,366	220,854
Tasmania	1,369,070	1,398,424	1,436,023	1,700,053	1,702,652
Northern Territory	101,138	100,611	82,182	105,119	90,956
Australia	15,160,631	15,215,956	13,059,166	17,553,691	19,641,925



MINE PRODUCTION OF PRINCIPAL METALS

(METALLIC CONTENT OF MINERALS)

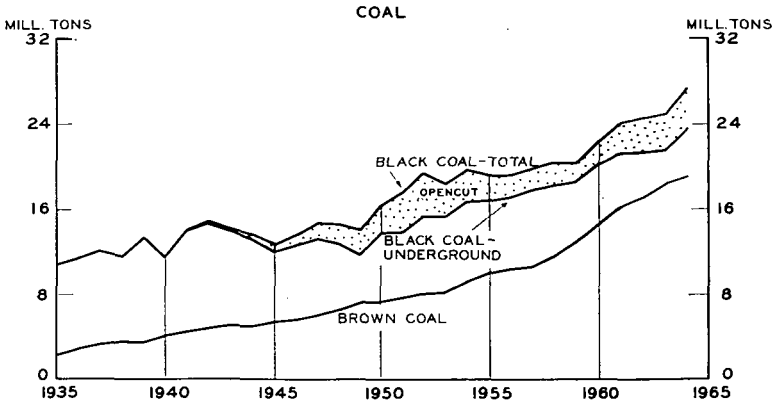
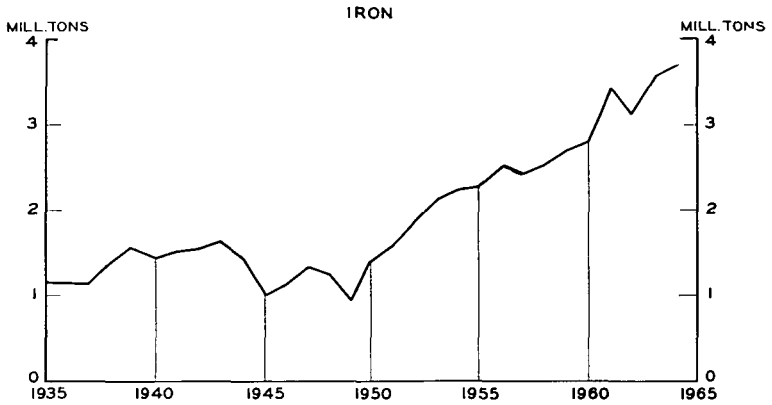
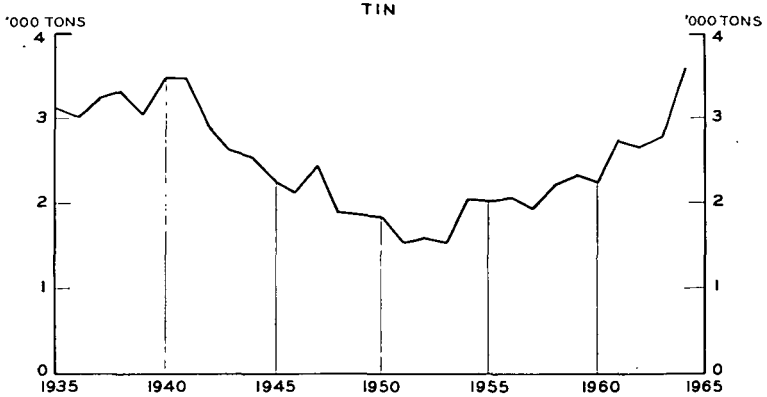
AUSTRALIA, 1935 TO 1964



MINE PRODUCTION OF PRINCIPAL METALS AND PRODUCTION OF COAL

(METALLIC CONTENT OF MINERALS)

AUSTRALIA, 1935 TO 1964



LEAD, SILVER AND ZINC: CONTENT OF ORES AND CONCENTRATES
PRODUCED—*continued*

State or Territory	1959	1960	1961	1962	1963
ZINC (tons)					
New South Wales	216,993	248,164	237,834	244,863	265,637
Queensland	23,468	34,775	33,219	44,704	37,344
South Australia .. ..	..	35	12	47	..
Tasmania	34,950	34,515	40,092	47,918	48,489
Northern Territory .. ..	..	..	(a)	..	..
Australia	275,411	317,489	311,157	337,532	351,470

(a) Less than half a ton.

4. **Smelter and Refinery Production.**—(i) *Lead.* The bulk of lead concentrate produced at Broken Hill is railed to Port Pirie, in South Australia, for smelting and refining. Lead-silver bullion is produced from initial smelting, and lead, silver and gold are then extracted as refined products. Cadmium is contained in the smelter fumes and is extracted, but this metal is more characteristically associated with zinc production. The sulphur dioxide gas formed during pre-smelter sintering operations is used to manufacture sulphuric acid. The antimony contained in the concentrate is alloyed with lead to form marketable antimonial lead, while the copper is recovered in various products which are sent to copper refineries for copper extraction.

In 1961 a new smelter was commissioned at Cockle Creek, New South Wales. It draws its supplies of lead and zinc concentrates from Broken Hill. This plant is unique in Australia in that the zinc content of lead concentrate is recovered. Previously this zinc content had accumulated in lead smelter slags. The bullion produced at this plant is exported for treatment while most of the refined zinc is used domestically. Sulphuric acid and cadmium are recovered as by-products. Some of the Broken Hill concentrate not treated at Port Pirie and Cockle Creek is exported for treatment overseas.

Lead ore and concentrate produced at Mount Isa is smelted at the mine to derive a lead bullion which is rich in silver. All this bullion is exported to the United Kingdom for refining. A lead-copper dross is produced as a by-product of lead smelting and this is also exported. Lead and lead-copper concentrates produced in Tasmania and lead concentrates produced in Western Australia are exported for smelting and refining overseas.

(ii) *Zinc.* A large proportion of the zinc concentrate produced at Broken Hill is exported, and the remainder is either shipped from Port Pirie to Risdon, near Hobart, or railed to Cockle Creek for smelting and refining. At Risdon the Broken Hill concentrate, together with all zinc concentrate produced in Tasmania, is roasted to form zinc oxide or calcine. Sulphur dioxide formed during this roasting process is used for the manufacture of sulphuric acid. The calcine is leached with a weak solution of sulphuric acid to form a zinc sulphate solution which, after purification, is electrolysed. Zinc of high purity is deposited on the cathodes and this zinc is melted and cast into ingots. Cadmium metal and cobalt oxide are also recovered. Zinc concentrate produced at Mount Isa is refined overseas.

The following table gives, for the years 1959 to 1963, particulars of the production and apparent consumption of refined primary lead, silver and zinc as recorded from data received from the Bureau of Mineral Resources.

REFINED LEAD, SILVER AND ZINC: PRODUCTION, CONSUMPTION AND EXPORTS, AUSTRALIA

Particulars	1959	1960	1961	1962	1963
LEAD (tons)					
Refined lead—					
Production(a)	185,805	189,823	162,264	190,125	224,605
Apparent consumption(a)(b)	31,900	33,200	29,800	34,100	44,500
Exports(c)	139,101	125,920	146,147	198,582	180,780
Silver-lead bullion (lead content)—					
Production(a)	50,310	52,723	48,090	73,110	80,661
Exports	52,650	49,305	45,767	75,482	75,994
SILVER ('000 fine oz.)					
Production(a)	7,805	8,085	7,099	7,378	8,871
Apparent consumption(a)	4,775	5,284	6,362	6,851	7,811
Exports	2,958	2,770	1,002	342	1,453
ZINC (tons)					
Production(a)	116,461	120,230	138,694	167,928	179,777
Apparent consumption(a)	78,753	91,840	77,495	84,747	92,100
Exports	41,606	27,443	46,472	91,215	96,775

(a) Source: Bureau of Mineral Resources.

(b) Excludes secondary lead.

(c) Includes small amount of secondary lead.

5. **Prices of Lead, Silver and Zinc.**—The following table shows average prices of lead, silver and zinc in Australia and on the London Metal Exchange during the years 1960 to 1964.

AVERAGE PRICES OF LEAD, SILVER AND ZINC

Particulars	1960	1961	1962	1963	1964
Australian prices, in £A. s. d.—					
Lead, per ton(a) .. £	100	99	82	85	120
Silver, per fine oz.(b) s. d.	8 3½	8 4¼	9 6½	11 5	11 8
Zinc, per ton(c) .. £	113	102	100	111	152
London Metal Exchange prices, in £Stg. s. d.—					
Lead, per ton .. £	72	65	57	63	100
Silver, per fine oz. s. d.	6 7½	6 7¼	7 7½	9 2	9 4
Zinc, per ton .. £	88	78	68	76	112

(a) Soft pig lead f.o.b. Port Pirie, from London Metal Exchange prices. c.i.f. Sydney basis.

(b) Silver prices shown represent export parity calculated

(c) Electrolytic zinc f.o.b. Risdon for 1960–62, subsequently

6. **Production in Principal Countries.**—The following table shows, for the years 1959 to 1963, particulars of lead, silver and zinc production (mine basis) in selected countries, together with the estimated world total.

LEAD, SILVER AND ZINC: MINE PRODUCTION IN SELECTED COUNTRIES

(Source: Minerals Yearbook, United States Department of the Interior)

Country	1959	1960	1961	1962	1963
LEAD ('000 tons)					
Australia	316	308	270	370	410
U.S.S.R.(a)	304	304	348	357	380
United States of America	228	220	234	212	236
Canada	167	184	163	189	178
Mexico	188	188	178	190	172
<i>World Total(a)</i>	<i>2,290</i>	<i>2,335</i>	<i>2,344</i>	<i>2,469</i>	<i>2,500</i>

SILVER ('000 fine oz.)					
Mexico	44,075	44,526	40,349	41,249	42,760
Peru	27,225	30,755	34,162	36,017	36,447
United States of America	31,194	30,766	34,794	36,798	35,000
Canada	31,924	34,017	31,382	30,669	30,739
U.S.S.R.(a)	25,000	25,000	25,000	27,000	27,000
Australia	15,161	15,216	13,059	17,554	19,642
<i>World Total(a)</i>	<i>221,900</i>	<i>240,500</i>	<i>236,500</i>	<i>242,400</i>	<i>249,500</i>

ZINC ('000 tons)					
United States of America	380	389	415	451	473
Canada	354	363	396	448	444
U.S.S.R.(a)(b)	330	339	393	393	402
Australia	275	317	311	338	351
Mexico	260	258	265	247	237
<i>World Total(a)</i>	<i>3,071</i>	<i>3,268</i>	<i>3,402</i>	<i>3,473</i>	<i>3,545</i>

(a) Estimated.

(b) Smelter production.

§ 7. Copper

1. **Historical.**—A brief history of copper-mining in Australia may be found in previous issues of the Year Book (see No. 48, p. 1070).

2. **Assistance to the Copper Mining Industry.**—For particulars, see pages 1134–5.

3. **Methods of Mining and Treatment.**—Most of the large copper ore bodies contain the mineral chalcopyrite, an iron-copper sulphide. Copper ore is mined by opencut methods at Mount Morgan, Mount Isa and Mount Lyell and by underground methods at Mount Isa, Ravensthorpe (Western Australia) and Tennant Creek (Northern Territory). Oxidized copper ore is mined at Mount Isa and at numerous other localities, mainly in Western Australia.

It is the practice for the sulphide ore to be finely ground and for the chalcopyrite contained in it to be recovered by flotation. At Mount Lyell and Mount Morgan the tailings from the copper flotation are subjected to a further flotation and a pyrite concentrate is produced. The oxidized ore mined at Mount Isa was, in the past, fed direct to the smelter for fluxing purposes, but since 1963 some has been concentrated. Large amounts of this oxidized ore have been removed from the open-cut, but only material actually smelted or concentrated is recorded as current production.

4. Mine Production.—The following table shows for 1963 the copper content of all minerals produced in the several States and the Northern Territory.

COPPER: CONTENT OF ORES AND CONCENTRATES PRODUCED, 1963
(tons)

Mineral in which contained	N.S.W.	Vic.	Q'land	S. Aust.	W. Aust.	Tas.	N.T.	Aust.
Copper ore, concentrate, and precipitate ..	118	6	82,382	5	1,889	15,352	7,147	106,899
Lead concentrate ..	3,320	..	839	..	30	125	..	4,314
Lead-copper concentrate ..	..	..	..	..	..	1,090	..	1,090
Zinc concentrate ..	426	..	..	..	..	238	..	664
Total	3,864	6	83,221	5	1,919	16,805	7,147	112,967

The following were the principal sources of copper during 1963.

Queensland. Mount Isa was the most important copper producing centre in Australia, its 1963 output being 65 per cent. of the Australian total. The copper produced at Mount Isa is contained in copper sulphide concentrate, oxidized copper ore and lead concentrate. Copper concentrate produced at Mount Morgan contained most of the remainder of the State's production.

Tasmania. Most of the State's production was at Mount Lyell, where copper is contained in copper concentrate, ore and precipitate. Lead-copper concentrate and lead concentrate milled at Rosebery contained the remainder of Tasmania's production.

Northern Territory. Copper concentrate from Tennant Creek and copper concentrate and precipitate from Rum Jungle contained almost all the Territory's output of copper.

The table hereunder shows the quantities of copper contained in minerals produced in the several States and the Northern Territory during the years 1959 to 1963.

COPPER: CONTENT OF ORES AND CONCENTRATES PRODUCED
(tons)

State or Territory	1959	1960	1961	1962	1963
New South Wales	3,728	3,572	3,510	3,747	3,864
Victoria	14	..	8	10	6
Queensland	66,798	82,753	66,505	79,242	83,221
South Australia	16	5	2	2	5
Western Australia	2,197	1,661	2,206	1,488	1,919
Tasmania	12,244	11,680	12,743	14,515	16,805
Northern Territory	9,953	9,764	10,652	7,968	7,147
Australia	94,950	109,435	95,626	106,972	112,967

5. *Smelter and Refinery Production of Copper.*—Most of the copper concentrate milled in Australia is smelted locally, blister copper being produced at Mount Isa, Mount Morgan, Mount Lyell and Port Kembla. Blister copper smelted at Mount Isa is railed to Townsville for electrolytic refining. Mount Lyell blister copper is electrolytically refined at Mount Lyell and the bulk is re-melted and cast into primary shapes at Port Kembla. Mount Morgan blister copper is shipped to Port Kembla, where, together with blister copper produced at Port Kembla, it is refined. All refined copper now produced in Australia is processed electrolytically. At Port Kembla gold and silver contained in electrolytic refining tank house slimes from Mount Lyell, Townsville, and Port Kembla are recovered.

In the following table details are given of the production and exports of blister and refined copper for the years 1959 to 1963.

METALLIC COPPER: PRODUCTION AND EXPORTS, AUSTRALIA

(Source: Bureau of Mineral Resources)

(tons)

Particulars	1959	1960	1961	1962	1963
Blister copper production ..	68,494	71,037	62,497	87,337	88,492
Refined copper production ..	51,593	70,652	63,723	79,450	86,115
Exports of blister and refinery shapes	18,974	14,079	24,095	16,497	24,949

6. *Prices.*—Details of average market prices for the years 1960 to 1964 are given in terms of Australian currency and sterling in the following table.

AVERAGE PRICES OF ELECTROLYTIC COPPER IN AUSTRALIA AND THE UNITED KINGDOM

(£ per ton)

Country	1960	1961	1962	1963	1964
Australia £A.(a)	324	307	305	305	328
United Kingdom £Stg.	239	228	232	234	332

(a) Ex works Port Kembla.

7. *Production in Principal Countries.*—The following table shows the mine production of copper for the years 1959 to 1963 in selected countries and the estimated world production in those years.

COPPER: MINE PRODUCTION IN SELECTED COUNTRIES

(Source: *Minerals Year Book*, United States Department of the Interior)

('000 tons)

Country	1959	1960	1961	1962	1963
United States of America ..	736	964	1,040	1,097	1,213
U.S.S.R.(a)	429	491	536	625	770
Chile	538	528	542	577	662
Rhodesia and Nyasaland ..	545	581	579	567	595
Canada	353	392	392	416	458
Australia	95	109	96	107	113
<i>World Total(a)</i> ..	<i>4,040</i>	<i>4,650</i>	<i>4,840</i>	<i>5,090</i>	<i>5,220</i>

(a) Estimated.

§ 8. Tin

1. **Historical.**—A brief history of tin-mining in Australia may be found in previous issues of the Year Book (*see* No. 48, p. 1073).

2. **Methods of Mining and Treatment.**—The greater part of tin concentrate production is obtained from alluvial workings as a gravity concentrate of cassiterite (tin oxide). The remainder is obtained from underground mining, where the tin mineralization is frequently associated with wolfram and sulphide minerals.

3. **Mine Production.**—The following table sets out the tin content of tin concentrate produced in Australia during the years 1959 to 1963. No tin production is recorded from minerals other than tin concentrate.

TIN: CONTENT OF TIN CONCENTRATES PRODUCED

(tons)

State or Territory	1959	1960	1961	1962	1963
New South Wales	174	223	173	212	250
Victoria .. ..	..	..	..	7	11
Queensland	1,104	885	1,350	1,077	1,196
Western Australia	174	190	231	323	363
Tasmania	890	884	986	1,058	1,005
Northern Territory	9	20	5	38	35
Australia	2,351	2,202	2,745	2,715	2,860

The following were the principal sources of production in 1963.

Queensland. Most of the tin concentrate produced was from the Herberton field, production being principally alluvial. Tin concentrate was also produced in the Chillagoe, Kangaroo Hills, Cooktown and Mareeba districts.

Tasmania. Most of the tin concentrate produced was won in the north-east part of the State from both lode and alluvial deposits. Wolfram concentrate, as well as tin concentrate, was produced.

Western Australia. Nearly all the tin concentrate produced was alluvial tin won from the Pilbara field.

4. **Smelter and Refinery Production.**—Except concentrate shipped to oversea smelters for technical reasons, the bulk of the production is treated by the two tin smelters located in Sydney.

The production of refined tin in Australia from locally produced tin concentrate during recent years, as recorded by the Bureau of Mineral Resources, was as follows:—1959, 2,226 tons; 1960, 2,254 tons; 1961, 2,546 tons; 1962, 2,704 tons; 1963, 2,626 tons; and 1964, 3,021 tons.

Consumption of refined tin has increased substantially in recent years following the introduction of tin-plate production in Australia; hot-dip plating began in 1957 and the electrolytic plant at Port Kembla, New South Wales, commenced operations early in 1962.

5. **Prices.**—Details of the movement in average market prices of tin for the years 1960 to 1964 are given in terms of Australian currency and sterling in the following table.

AVERAGE PRICE OF TIN IN AUSTRALIA AND THE UNITED KINGDOM
(£ per ton)

Country	1960	1961	1962	1963	1964
Australia £A (a)	1,042	1,169	1,163	1,179	1,598
United Kingdom .. £stg.(b)	794	895	898	909	1,217

(a) Delivered, Sydney.

(b) London Metal Exchange price.

6. **Production in Principal Countries.**—World production of tin reached its maximum in 1941, when 241,400 tons were recorded. Australia's contribution to the world's tin production is slightly above 1 per cent.

Mine production of tin for selected principal producing countries and Australia and the estimated world totals for 1959 to 1963 are given in the following table.

TIN: MINE PRODUCTION IN SELECTED COUNTRIES
(Source: *Minerals Year Book*, United States Department of the Interior)
(tons)

Country	Production				
	1959	1960	1961	1962	1963
Malaya, Federation of ..	37,525	51,979	56,028	58,603	59,947
China(a)	26,000	28,000	30,000	28,000	28,000
Bolivia	23,811	19,407	20,409	21,492	22,752
U.S.S.R.	15,000	16,000	17,000	17,000	20,000
Thailand	9,684	12,080	13,270	14,679	15,587
Indonesia	21,613	22,596	18,574	17,310	12,947
Australia	2,351	2,202	2,745	2,715	2,860
<i>World Total(b)</i> ..	<i>161,500</i>	<i>180,400</i>	<i>184,100</i>	<i>187,000</i>	<i>190,300</i>

(a) Estimated smelter production.

(b) Estimated.

§ 9. Iron

1. **Historical.**—A brief history of the iron and steel industry may be found in previous issues of the Year Book (*see* No. 50, p 1162).

2. **Recent Developments in the Iron and Steel Industries.**—In December, 1960, the Commonwealth Government announced a partial relaxation of the embargo on the export of iron ore which had been in force since 1938. This relaxation was further increased in 1963 after it became evident that reserves of iron ore in Australia are very extensive. Permission has been granted for the export of iron ore from Talling Peak-Koolanooka Hills, Mount Goldsworthy, the Hamersley and Ophthalmia Ranges and the Scott River area in Western Australia, and from small deposits in New South Wales and Queensland. A number of development agreements have been signed, mainly in Western Australia, for mining leases over important reserves of iron ore, and negotiations for the export of iron ore to Japan have been concluded in a number of instances.

Exports of iron ore in the future will be mainly from Western Australia. In December, 1963, the Western Mining-Hanna-Homestake consortium signed a contract with a group of Japanese steel mills to ship ore from the Talling Peak-Koolanooka Hills area to Japan. According to the terms of the contract, a total of 5.1 million tons of ore will be exported over a period of eight years from April, 1966. Shipments of iron ore are also due to start in April, 1966, from the deposits at Mount Goldsworthy, east of Port Hedland. Japanese steel mills have agreed to purchase 16.5 million tons of iron ore from Mount Goldsworthy Mining Associates over a period of seven years. A harbour deepening programme at Port Hedland costing about £5 million has been initiated, and overall cost of the development project, including construction costs of railway facilities from Mount Goldsworthy to Port Hedland, may exceed £20 million.

Major developments for the export of iron ore will take place at Mount Tom Price in the Hamersley Range and Mount Whaleback in the Ophthalmia Range. An offer by Hamersley Iron Pty. Ltd. to export iron ore to Japanese steel mills has been accepted, and 65.5 to 75 million tons of ore will be shipped over 16 to 18 years, with shipments beginning in August, 1966. A similar large scale offer by Mount Newman Iron Ore Co. Ltd. has also been accepted and 100 million tons of ore will be shipped over 21 to 22 years with shipments commencing in 1969. Both of these companies have signed with the Western Australian Government agreements which provide for the eventual establishment of a steel industry in Western Australia. Developments for the export of iron ore may also take place in the Robe River area of the Pilbara district, where Cleveland Cliffs Iron Mining Company proposes to produce pellets for export to Japan.

A small contract for the export of iron ore from the Frances Creek area in the Northern Territory has been signed, and the export of three million tons of ore over eight years is expected to begin in 1967. Exports of iron ore may also eventuate from Tasmania, and an investigation programme is under way at Savage River to determine the feasibility of an iron ore mining and pellet production operation.

It has been estimated that by 1970 Australia's iron ore exports will be about 12 to 15 million tons annually. However, the actual annual tonnage will depend upon specific delivery dates of contracts which have yet to be finalized.

Expansion of the domestic steel industry continues. In May, 1965, the Broken Hill Proprietary Co. Ltd. opened a new steelworks at Whyalla. The plant, built at a cost of approximately £50 million, has an initial capacity of 500,000 tons of steel ingots a year.

Within two years development plans provide for an increase in capacity to 900,000 ingot tons a year; the major project in this programme being the construction of two batteries of coke ovens to cost £10 million. Capital expenditure in the Australian iron and steel industry is currently of the order of £40 million to £50 million annually.

3. **Mine Production of Iron Ore.**—Iron oxide deposits exist in all States and in the Northern Territory, but at present iron oxide for metal extraction purposes, termed iron ore in this chapter, is produced in two States only. The following table shows the estimated iron content of iron ore produced during the years 1959 to 1963.

IRON: ESTIMATED IRON CONTENT OF IRON ORE PRODUCED
(tons)

State	1959	1960	1961	1962	1963
South Australia	2,218,846	2,227,551	2,581,313	2,235,832	2,717,926
Western Australia	480,769	586,404	852,663	883,263	839,877
Australia	2,699,615	2,813,955	3,433,976	3,119,095	3,557,803

The producing centres during 1963 were as follows.

South Australia. 4,181,424 tons of iron ore were drawn from the Iron Monarch and Iron Prince quarries in the Middleback Ranges. Selected foundry grade ore was diverted as required to the Whyalla blast furnace, but the greater part was shipped to Newcastle and Port Kembla for smelting. Production of beneficiated iron ore commenced at Iron Knob in the latter part of 1962.

Western Australia. Ore shipped from Yampi Sound, north of Derby, to New South Wales for sintering and smelting amounted to 1,277,613 tons. A quantity of 55,525 tons was mined at Koolyanobbing, near Southern Cross, for pig iron production at Wundowie.

4. **Mine Production of Iron Oxide.**—Small quantities of iron oxide are mined in five Australian States. New South Wales and South Australia are the major producers. In 1963 Australian production was 40,061 tons, of which 47 per cent. was for cement manufacture, 45 per cent. for fluxing in metallurgical processes, 5 per cent. for coal washing and 3 per cent. for gas purification.

5. **Smelter and Refinery Production.**—The production of pig-iron and steel ingots in Australia, of which New South Wales is the main producing State, is shown in the following table.

PIG-IRON AND INGOT STEEL: PRODUCTION, AUSTRALIA
(tons)

Commodity	1959	1960	1961	1962	1963
Pig-iron(a)	2,506,514	2,876,267	3,156,411	3,434,336	3,624,673
Ingot steel(b)	3,395,261	3,693,770	3,884,929	4,170,830	4,574,546

(a) Excludes ferro-alloys.
steel castings.

(b) Includes recovery from scrap, but excludes production of direct

6. **Production of Iron and Steel in Principal Countries.**—Particulars of the production in the seven principal countries and Australia and the estimated world total production during the calendar years 1962 and 1963 are shown in the following table.

IRON AND STEEL: PRODUCTION IN SELECTED COUNTRIES

(Source: *Minerals Yearbook*, United States Department of the Interior)

('000 tons)

Country	Pig-iron and ferro-alloys		Ingot steel and castings	
	1962	1963	1962	1963
United States of America ..	60,389	65,940	87,793	97,555
U.S.S.R.	54,643	57,773	75,089	78,953
Germany, Federal Republic of ..	23,868	22,547	32,049	31,098
Japan	18,147	20,112	27,111	31,004
United Kingdom	13,830	14,591	20,491	22,520
France	13,384	14,272	16,968	17,279
China (Mainland)	17,679	16,696	11,607	11,607
Australia	3,464	3,672	4,221	4,625
<i>World Total(a)</i>	<i>263,000</i>	<i>275,866</i>	<i>354,800</i>	<i>379,741</i>

(a) Estimated.

In 1964 eleven blast furnaces were operating in Australia; four at Port Kembla and four at Newcastle in New South Wales, two at Wundowie in Western Australia, and one at Whyalla, South Australia. Production of pig-iron in 1964 was at a record level. The fourth blast furnace at Newcastle, with a daily capacity of 1,400 tons of pig-iron, was commissioned in July, 1963.

During 1964 the bulk of Australia's ingot steel production was obtained from 17 open hearth furnaces (13 at Port Kembla and 4 at Newcastle). In addition, 3 other open hearth furnaces and 15 electric furnaces were in operation during 1964 for the production of special steels and ferro-alloys. The use of oxygen in steel-making continued to be of great importance in Australia during 1964. All furnaces in the No. 2 open hearth shop at Port Kembla are now using oxygen lancing equipment and two basic oxygen steel-making units were in operation at Newcastle throughout the year. Annual steel-making capacity in Australia is now in excess of 5 million tons.

§ 10. Mineral Sands

1. **Historical.**—A brief history of mineral sands mining in Australia may be found in previous issues of the Year Book (see No. 50, p. 1166).

2. **Methods of Mining and Treatment.**—Mining on the east coast of Australia is mainly by suction dredging. In Western Australia ilmenite is mined hydraulically or by earth-moving equipment. Heavy mineral concentrates are recovered by wet gravity concentration, using a combination of concentrating spirals and shaking tables. The constituent minerals of the heavy-mineral concentrates, mainly rutile, zircon, ilmenite and monazite, are separated by electromagnetic and electrostatic methods.

3. **Mine Production.**—(i) *Titanium Dioxide.* The following table shows the quantities of titanium dioxide contained in rutile and ilmenite concentrates produced during the years 1959 to 1963.

TITANIUM DIOXIDE: CONTENT OF CONCENTRATES PRODUCED

(tons)

State	1959	1960	1961	1962	1963
-------	------	------	------	------	------

CONTAINED IN RUTILE CONCENTRATE

New South Wales	44,792	52,262	64,284	77,227	129,931
Queensland	34,736	33,260	33,056	37,472	45,454
Western Australia	96	493	880	501	732
Australia	79,624	86,015	98,220	115,200	176,117

CONTAINED IN ILMENITE CONCENTRATE

New South Wales	111	537	905	1,930	2,689
Queensland .. ..	..	21	2	..	..
Western Australia	45,788	58,169	92,838	98,364	109,244
Australia	45,899	58,727	93,745	100,294	111,933

The Western Australian production figures for ilmenite concentrate for the years 1959 to 1963 include the following quantities of titanium dioxide contained in leucocoxene: 1959, 222 tons; 1960, 71 tons; 1961, 428 tons; 1962, 532 tons; 1963, 472 tons.

(ii) *Zircon.* The quantities of zircon mineral contained in zircon concentrate produced during the years 1959 to 1963 are shown in the following table.

ZIRCON: CONTENT OF ZIRCON CONCENTRATE PRODUCED

(tons)

State	1959	1960	1961	1962	1963
New South Wales	71,156	65,764	98,421	89,947	117,520
Queensland	34,504	31,752	28,775	38,468	52,193
Western Australia	6,692	3,978	7,287	3,694	12,399
Australia	112,352	101,494	134,483	132,109	182,112

(iii) *Other Products.* During 1963 small quantities of monazite concentrate, magnetite and garnet concentrate were also recovered from mineral sands.

4. *Sources of Production.*—The principal sources of mineral sands treated during 1963 were as follows.

New South Wales and Queensland. The main deposits of mineral sands occur along the eastern Australian coast from Wyong in New South Wales to Curtis Island, Queensland. At present the principal mining operations are located between Lake Munmorah and Newcastle in the south, between Laurieton and Crescent Head on the central coast, and between Byron Bay and North Stradbroke Island in the north. Most mining operations are now confined to dunes and swampy areas lying behind beaches.

Western Australia. The chief deposits of mineral sands occur in the south-west corner of the State, between Bunbury and Wonnerup. During 1963 the bulk of production was from inland deposits in the Capel-Yoganup area.

§ 11. Aluminium

1. **Historical.**—The aluminium production industry in Australia is of comparatively recent origin. Following legislation enacted in 1944, the Commonwealth and Tasmanian Governments together formed the Australian Aluminium Production Commission and subsequently initiated construction of an alumina refinery and an aluminium reduction plant at Bell Bay in Tasmania. Plant capacity was 13,000 tons of aluminium metal per annum and production began in February, 1955. Supplies of bauxite for the plant were drawn from Malaya, Indonesia and India, as the then known Australian bauxite deposits were unsuitable because of technical and economic considerations.

This situation changed in the ensuing years as it became clear that three major deposits of bauxite existed in Australia. In 1952 bauxite had been found at Gove, on the north-eastern tip of the Northern Territory, but the importance of this discovery did not become evident until later. Subsequently, in 1955, the bauxite deposits at Weipa on the eastern shores of the Gulf of Carpentaria were discovered and investigated. Shortly after bauxite was found at Weipa, investigations were begun of bauxite deposits in the Darling Ranges, south-east of Perth. Each of these deposits was considered, after examination, to be of sufficient size and quality to form the basis of separate aluminium production complexes.

During 1960 the Commonwealth Government disposed of its share in the Bell Bay project to Comalco Industries Pty. Ltd. A £10 million expansion plan was subsequently initiated at Bell Bay and plant capacity was increased to 52,000 tons of aluminium per annum by 1963. At the same time the same group proceeded with a £5 million development programme at Weipa. Construction of port facilities at Weipa was completed in 1963 and large scale bauxite shipments to Bell Bay and overseas began. During 1963 plans for an alumina refinery to be situated at Gladstone in Queensland were announced; these plans were later modified as two overseas aluminium companies entered this project, which now involves an alumina refinery with a capacity of about 600,000 tons per annum. The cost of building the refinery and ancillary facilities will be about £50 million.

In mid-1961 it was announced that the Aluminium Company of America would participate with three Australian companies in the establishment of an integrated aluminium industry based on the bauxite deposits of the Darling Ranges. Subsequently quarrying operations were developed at Jarrahdale, and an alumina refinery was built at Kwinana in Western Australia with production of alumina beginning in late 1963. At the same time an aluminium smelter was established by this group at Point Henry in Victoria, with an initial capacity of 20,000 tons per annum. Production of aluminium metal at this plant began in March, 1963, from imported alumina, and plant capacity was later increased to 40,000 tons per annum.

In February, 1963, it was announced that leases for the mining of bauxite would be granted to Gove Mining and Industrial Corporation Ltd., an Australian subsidiary of the Pechiney group. These leases are located in the "perimeter" area at Gove. The terms require the lessee to mine and export 10 million tons of bauxite over a period of 18 years; this operation will involve the construction of a port and the immediate expenditure of about £2 million. The lessee is required to spend £300,000, over a three-year period from the granting of the leases, in further exploration and in assessing the economic feasibility of a 500,000 tons per annum alumina plant. Within the same period the lessee is required to submit a plan for development of the leased areas, including erection of the alumina plant by the end of 1970.

In May, 1963, the Commonwealth Government announced its decision to cancel the lease over the central portion of the Gove deposits held by the British Aluminium Company Limited. Subsequent tenders for the mining leases of the inner bauxite deposits were still under consideration in May, 1965.

2. **Current Developments.**—Current developments in the Australian aluminium industry centre round the inner Gove leases, the alumina refinery being built at Gladstone (Queensland), the establishment of a power station at Anglesea (Victoria), and the expansion of the alumina refinery at Kwinana (Western Australia).

On 15th March, 1965, tenders closed for the development of the inner bauxite deposits at Gove. The Commonwealth Government's major policy objectives in respect of leases for the development of these deposits have been stated as: an immediate firm commitment for an alumina plant of at least 300,000 tons capacity in the Northern Territory, provided there is sufficient ore of satisfactory quality; provision for Australian equity participation in the project; clear demonstration of the availability of adequate market outlets and ability to organize and finance the project; and a willingness to establish an alumina smelter in the Northern Territory when this could be done on a demonstratively economic basis.

The construction of an alumina refinery at Gladstone by Queensland Alumina Ltd. is proceeding and is expected to be completed in 1967. Construction of a power station at Anglesea to provide power in the future for the Point Henry smelter is also proceeding. This power station, which is being built by Alcoa of Australia Pty. Ltd., will have a capacity of 150 MW and will cost £13 million. It is expected that the station will be completed in 1969. The Kwinana alumina refinery is being expanded at a cost of £7 million and capacity will be increased to about 400,000 tons per annum by 1967.

3. **Mine Production.**—The mineral source of aluminium is bauxite. Bauxite production, for Australia, in terms of alumina content, is shown for the years 1959 to 1963 in the following table.

ALUMINA: CONTENT OF BAUXITE PRODUCED

(tons)

State	1959	1960	1961	1962	1963
New South Wales	1,648	1,386	929	1,991	2,801
Victoria	1,991	2,306	2,035	2,300	1,161
Queensland .. ..	..	14,442	4,500	8,959	129,371
Western Australia	3,275	13,259	..	..	21,166
Australia	6,914	31,393	7,464	13,250	154,499

4. **Refinery Production.**—There is a refinery for the production of alumina and refined aluminium at Bell Bay on the River Tamar in Northern Tasmania. The location of this refinery was determined by the availability of large supplies of hydro-electric power. Production of alumina commenced in February, 1955, and production of refined aluminium in September, 1955. The capacity of the Bell Bay plant was increased to 35,000 tons in 1962 and was further increased to 52,000 tons in 1963. Another smelter with a total capacity of 40,000 tons was commissioned at Geelong (Victoria) in two stages in 1963. The following table shows the production of alumina and refined aluminium in Australia during the years 1959 to 1963.

ALUMINA AND REFINED ALUMINIUM: PRODUCTION, AUSTRALIA

(Source: Bureau of Mineral Resources)

(tons)

Product	1959	1960	1961	1962	1963
Alumina	26,900	29,801	29,468	33,806	46,350
Refined aluminium	11,370	11,655	13,204	16,152	41,263

§ 12. Uranium

1. **Historical.**—Uranium mineralization was first recorded in Australia at Carcoar in New South Wales during 1894. However, the only two significant occurrences of uranium in Australia known in 1944 were at Radium Hill and Mount Painter, both in South Australia. Radium Hill was discovered in 1906 and Mount Painter in 1910, and each was mined spasmodically for radium up to 1934, but both mines were finally forced to close down because of the complexity of the ores and the discovery of extensive reserves of pitchblende at Great Bear Lake in Canada.

The active search for uranium in Australia commenced in 1944 at the request of the United Kingdom Government, when uranium was urgently required for defence purposes. In the same year Commonwealth and South Australian Government geologists and geophysicists examined the Mount Painter and Radium Hill deposits. Tests proved these deposits to be of low grade and the project was abandoned. By 1950, however, experimental and exploratory work indicated that a suitable treatment process could be developed for Radium Hill ore.

In the meantime the Commonwealth, in 1947, sought the co-operation of State authorities in a general search for uranium. The Commonwealth Bureau of Mineral Resources investigated several radioactive occurrences, and assisted with technical advice to prospectors and manufacturers of relevant electronic equipment. From these beginnings the search for uranium ore expanded progressively as staff and funds became available.

In January, 1948, the Commonwealth Government instituted a system of tax-free rewards for discoveries of uranium ore. Rewards payable ranged to a maximum of £25,000 and were designed to encourage individual prospectors and small syndicates to take up the search. To encourage the mining of uranium ores approval was given in August, 1949, for the establishment for five years of a uranium ore buying pool in Australia. As a further incentive to uranium mining the Income Tax Assessment Act was amended during 1952 to exempt from tax profits earned by companies engaged in uranium mining and treatment, provided that no less than three-quarters of the voting power in the company concerned was controlled by persons resident in Australia. This exemption was later extended to income derived from uranium mining by taxpayers resident in Australia.

The discovery of uranium at Rum Jungle was made late in 1949. Prospecting and mining investigations were begun by the Bureau of Mineral Resources early in 1950, but the first high-grade ore-body was not discovered until December, 1951.

In March, 1952, the United States Atomic Energy Commission sent a party of experts to Australia at the invitation of the Commonwealth and South Australian Governments. Discussions took place regarding a basis for development of the Rum Jungle and Radium Hill fields. Agreement was reached on broad principles, and arrangements were made later for funds for the project to be provided by the Combined Development Agency—the joint Anglo-American uranium purchasing organization. The agreement with the Combined Development Agency was formally executed in January, 1953.

During August, 1952, the Commonwealth Government reached an agreement with Consolidated Zinc Pty. Ltd., for the development of the Rum Jungle area. On 1st January, 1953, Territory Enterprises Pty. Ltd., a wholly-owned subsidiary of Consolidated Zinc Pty. Ltd., took control of all work within the hundred of Goyder as agent for the Commonwealth Government. The exploration programme in this region was continued. Open-cut mining of the deposit began in September, 1954, and the treatment plant—the first uranium mill in Australia—was opened in the same month. Production of uranium oxide in the period September, 1954, to January, 1963, when the contract with Combined Development Agency expired, was in excess of 1,500 short tons. Since the completion of the contract the Commonwealth Government has continued production at the Rum Jungle plant.

While the Rum Jungle project was proceeding development was also occurring at Radium Hill. In 1952 a contract was signed by the Commonwealth Government, South Australian Government and the Combined Development Agency for the purchase of the uranium oxide concentrate output of Radium Hill by the Combined Development Agency. The agreement covered a seven-year period of full production. Full-scale mining commenced at Radium Hill in November, 1954, and concentrates were stockpiled until chemical extraction began at Port Pirie in August, 1955. This contract expired on 31st December, 1961, and the mine at Radium Hill and the treatment plant at Port Pirie were subsequently closed down in view of diminishing reserves of ore and the absence of a suitable market.

During 1954 there was intense activity in Australia in the search for uranium. In the previous year the Bureau of Mineral Resources had discovered uranium mineralization in the South Alligator River area, and further exploration and testing proceeded in this area. About the same time attention focused on a small area just south of the Mount Isa-Cloncurry road where a member of a small syndicate discovered the Mary Kathleen uranium deposit in June, 1954. Mary Kathleen Uranium Ltd. was formed, and in March, 1956, an agreement for the supply of uranium to the value of some £40 million was signed by Rio Tinto Company of Australia, Mary Kathleen Uranium Ltd., and the United Kingdom Atomic Energy Authority. Production of uranium oxide commenced during June, 1958. Following completion of the contract, mining operations were suspended late in 1963 and the plant and township placed on a care and maintenance basis. Production of uranium oxide during the term of the contract was about 4,500 short tons.

Two companies carried out large scale mining and treatment operations in the South Alligator River area. United Uranium N.L. opened a treatment plant at Moline in May, 1959, and subsequently completed a contract to the value of about £5 million. South Alligator Uranium N.L. opened a treatment plant in September, 1959, and subsequently completed a smaller contract to the value of approximately £1.15 million.

There has been little interest in the search for uranium deposits in recent years as a result of temporary world-wide over-supply, and early in 1961 the Australian Atomic Energy Commission announced that no applications for discovery rewards would be considered after 31st March, 1961.

2. **Mine Production.**—Uranium prospecting and mining in the Territories of the Commonwealth are open to private enterprise, subject to the *Atomic Energy Act 1953-1958* and the Ordinances of the Territories. The development of the uranium resources of the States is governed by the legislation and policies of the various State Governments. Commonwealth assistance, in the form of aerial, geological and geophysical services, is available to the States, and State Mines Departments inspect uranium prospects and test samples submitted by prospectors.

The Rum Jungle uranium mine will be kept in operation despite expiration of the original sales contract. Operations are being sustained at approximately previous levels, and the uranium oxide produced is available for sale overseas. The decision to continue operations was taken in the light of the fact that as well as being successful financially, operations at Rum Jungle have made a significant contribution to the development of the Northern Territory. The Commonwealth Government decided, therefore, that the profits it had made would be re-invested in the Northern Territory. Exploration is continuing to determine whether or not further ore bodies exist in the area. A recently discovered copper ore deposit is now being mined by a private company and the ore is being treated in the Rum Jungle plant on a toll basis.

§ 13. Other Metallic Minerals

1. **Tungsten.**—In recent years Tasmania has been the principal State producing tungsten ores, scheelite being mined on King Island in Bass Strait and wolfram being mined in association with tin ores in the north-east part of the State. Because of low world prices, scheelite production on King Island ceased in August, 1958, but production was recommenced in 1960. Low prices persisted and production in subsequent years was on a limited scale. The State Government ceased advances to the company producing scheelite on King Island on 31st May, 1964. Payments under the Act amounted to £36,029 in respect of 1964 production. The payments were to forestall a threatened mine closure.

Particulars of the production of tungstic oxide contained in scheelite and wolfram concentrates produced during the years 1959 to 1963 are shown in the following table.

TUNGSTIC OXIDE (WO₃): CONTENT OF CONCENTRATES PRODUCED (tons)

State	1959	1960	1961	1962	1963
CONTAINED IN SCHEELITE CONCENTRATE					
New South Wales	(a)	(a)	(a)	..	..
Western Australia .. ..	..	..	..	5	..
Tasmania .. ..	..	291	709	686	675
Australia	(a)	291	709	691	675
CONTAINED IN WOLFRAM CONCENTRATE					
New South Wales .. ..	..	..	(a)	..	..
Queensland .. ..	..	..	1	1	..
Tasmania	645	804	810	349	285
Northern Territory	8	16	16	1	..
Australia	653	820	827	351	285

(a) Less than one half ton.

2. **Manganese.**—In recent years Western Australia has been the principal State producing manganese ore, mined mainly from the Pilbara goldfield.

The following table shows the manganese content of metallurgical grade and the manganese dioxide content of battery and other grades of manganese ore produced during the years 1959 to 1963.

MANGANESE: CONTENT OF MANGANESE ORE PRODUCED

(tons)

Year	Metallurgical grade (In terms of manganese (Mn) content)				Battery and other grades (In terms of manganese dioxide (MnO ₂) content)					
	N.S.W.	Q'land	W. Aust.	Aust.	N.S.W.	Q'land	S. Aust.	W. Aust.	N.T.	Aust.
1959 ..	620	4,350	35,996	40,966	907	..	..	221	1,406	2,534
1960 ..	342	1,670	26,561	28,585	623	..	45	450	940	2,058
1961 ..	..	1,109	39,686	40,795	632	..	192	529	76	1,429
1962 ..	..	1,296	32,207	33,503	424	..	..	900	188	1,512
1963 ..	..	..	16,947	16,947	467	114	..	527	120	1,228

(a) Includes Victoria (12 tons).

The quantity of manganese dioxide recovered at the Risdon, Tasmania, refinery during 1963 amounted to 4,100 tons, of which 582 tons were sold for chemical processing and trace element fertilizer.

3. **Other.**—Other metallic minerals produced in Australia during 1963 were—antimony, beryllium, chromite, tantalite-columbite and small amounts of bismuth, molybdenite and platinum concentrate. Production data may be found on pages 1145–8.

§ 14. Coal

1. **Historical.**—A brief history of coal-mining in Australia may be found in previous issues of the Year Book (see No. 48, p. 1086).

2. **Joint Coal Board.**—For details of the powers and functions of this Board, which has functioned since 1947, see page 887 of Year Book No. 39.

3. **Coal Industry Tribunal.**—The Coal Industry Tribunal was established under the Commonwealth *Coal Industry Act* 1946 and the New South Wales *Coal Industry Act*, 1946 to consider and determine interstate disputes and, in respect of New South Wales only, intra-state disputes between the Australian Coal and Shale Employees' Federation and employers in the coal-mining industry. Following legislation in 1951, the Tribunal was vested with authority to deal with all interstate industrial disputes in the coal-mining industry, irrespective of the trade union involved, and, in the case of New South Wales, intra-state disputes also. The Tribunal consists of one person who may appoint two assessors nominated by the parties to advise him in matters relating to any dispute.

4. **Australia's Coal Reserves.**—The latest available estimates of the measured and indicated coal reserves of Australia are those prepared by the Mines Departments in the various States for the Coal Utilization Research Advisory Committee whose report was issued by the Department of National Development in 1962. This information is shown in the following table. It should be noted that reserves can only be included in the "measured and indicated" categories when sufficient exploratory and testing work has been completed.

ESTIMATED COAL RESERVES OF AUSTRALIA

(Source: State Mines Departments)

(million tons)

State	Type of coal	Measured and indicated	Inferred
New South Wales	Bituminous	(a) 3,000	(b)
Victoria	"	20	10
"	Brown	54,700	43,000
Queensland	Bituminous, sub-bituminous ..	950	(c)
South Australia	Sub-bituminous	130	..
"	Lignite	530	..
Western Australia	Sub-bituminous	274	1,603
Tasmania	Bituminous	(d)	(e) 137

(a) Recoverable reserves. (b) In excess of 30,000 million tons. (c) In excess of 10,000 million tons. (d) Very small; measured reserves in Tasmania amount to only several thousand tons. (e) Includes both indicated and inferred reserves.

5. Mine Production of Black Coal.—Production of black coal according to rank in the several States during the years 1960 to 1964 is set out in the following table. The tonnages produced by underground mining and opencut mining are also shown.

BLACK COAL: PRODUCTION

(tons)

Particulars	1960	1961	1962	1963	1964
NEW SOUTH WALES					
Total(a)	17,736,994	19,020,805	19,030,418	18,940,206	20,699,056
Underground mines	16,981,561	18,188,613	18,195,881	18,337,767	19,982,720
Opencut mines ..	755,433	832,192	834,537	602,439	716,336
VICTORIA					
Total(b)	76,972	66,363	56,721	50,481	48,118
QUEENSLAND					
Semi-anthracite	47,762	56,437	67,652	58,522	71,500
Bituminous	2,531,581	2,650,367	2,648,200	3,072,320	3,616,212
Sub-bituminous	70,769	75,362	82,989	113,317	121,123
Total	2,650,112	2,782,166	2,798,841	3,244,159	3,808,835
Underground mines	2,269,564	2,157,790	2,194,351	2,427,611	2,730,033
Opencut mines ..	380,548	624,376	604,490	816,548	1,078,802

NOTE.—For footnotes see next page.

BLACK COAL: PRODUCTION—continued
(tons)

Particulars	1960	1961	1962	1963	1964
SOUTH AUSTRALIA					
<i>Total(c)</i>	884,819	1,115,156	1,392,085	1,511,719	1,736,113
WESTERN AUSTRALIA					
<i>Total(d)</i>	922,393	765,740	919,112	902,495	987,420
Underground mines	798,185	506,306	598,502	600,933	644,107
Opencut mines ..	124,208	259,434	320,610	301,562	343,313
TASMANIA					
Semi-anthracite ..	2,333	2,142	1,649	2,081	1,529
Bituminous	295,337	253,686	270,693	205,199	149,632
<i>Total</i>	297,670	255,828	272,342	207,280	151,161
Underground mines	281,662	241,812	262,137	205,918	151,161
Opencut mines ..	16,008	14,016	10,205	1,362	..
AUSTRALIA					
Semi-anthracite ..	50,095	58,579	69,301	60,603	73,029
Bituminous	20,640,884	21,991,221	22,006,032	22,268,206	24,513,018
Sub-bituminous ..	1,877,981	1,956,258	2,394,186	2,527,531	2,844,656
<i>Total</i>	22,568,960	24,006,058	24,469,519	24,856,340	27,430,703
Underground mines	20,407,944	21,160,884	21,307,592	21,622,710	23,556,139
Opencut mines ..	2,161,016	2,845,174	3,161,927	3,233,630	3,874,564

(a) Bituminous coal from an opencut mine.

(b) Bituminous coal from underground mines.

(c) Sub-bituminous coal.

(d) Sub-bituminous coal.

The principal producing centres during 1963 were as follows.

New South Wales. The principal deposits worked were in the vicinity of Newcastle, Cessnock and Singleton (northern field), Lithgow (western field), and Wollongong (southern field). Tonnages mined in 1963 were: northern field, 9,484,000 tons; southern field, 7,817,000 tons; and western field, 1,639,000 tons. All opencut coal was from the northern field.

The coal fields of New South Wales, predominantly bituminous, are the most important in Australia, in respect of the magnitude, quality and accessibility of reserves and the extent to which the deposits are being worked. Coal from the various seams differs in properties, coal from the Greta seam worked in the vicinity of Cessnock being particularly suitable for gas-making, while coal from the Victoria Tunnel, Dudley, Young Wallsend, and Borehole seams,

all of which are mined near Newcastle, have coking properties and are used in the steelworks. Coking coal is also obtained from the Bulli seam which is mined near Wollongong and in the Burragorang Valley. A multi-purpose coal is available in the Singleton area, and steaming coals are mined around Newcastle, Lithgow, Cessnock, and Wollongong.

Queensland. The principal producing centres were Ipswich, 1,801,765 tons; Bowen, 358,402 tons; Mount Morgan, 639,423 tons; Maryborough, 163,218 tons; and Clermont, 149,957 tons. Opencut methods were used on the Bowen, Clermont and Mount Morgan fields, and the total coal won by this means was 34 per cent. of total production.

6. Production of Black Coal Per Man-shift.—(i) *Underground Mines.* The following table shows particulars of estimated black coal output per man-shift worked, (a) at the coal face, and (b) by all employees, in respect of underground mines for each State concerned and for Australia for the years 1959 to 1963. These estimates have been calculated by the Joint Coal Board from data collected fortnightly in respect of coal production and the number of man-shifts actually worked. In South Australia black coal is won only by opencut mining.

PRODUCTION OF BLACK COAL PER MAN-SHIFT: UNDERGROUND MINES
(tons)

Year	N.S.W.	Vic.	Q'land	W. Aust.	Tas.	Australia
PRODUCTION PER MAN-SHIFT WORKED AT COAL FACE						
1959	18.07	2.10	7.53	7.60	7.34	14.13
1960	20.64	2.16	8.37	8.12	7.64	16.08
1961	24.61	2.15	8.69	8.09	8.77	19.04
1962	25.92	1.94	9.25	8.90	11.04	20.13
1963	27.26	2.12	10.74	9.25	13.76	21.56
PRODUCTION PER MAN-SHIFT WORKED BY ALL EMPLOYEES						
1959	4.90	0.93	2.95	3.35	3.72	4.37
1960	5.39	0.94	3.19	3.62	3.87	4.81
1961	6.23	0.83	3.46	4.00	4.09	5.55
1962	6.57	0.78	3.57	4.32	4.71	5.84
1963	7.04	0.82	4.02	4.37	4.90	6.26

(ii) *Opencut Mines.* In the next table the Joint Coal Board's estimates of production of black coal per man-shift worked by all employees in opencut mines are shown. There are no opencuts producing black coal in Victoria.

PRODUCTION OF BLACK COAL PER MAN-SHIFT: OPENCUT MINES
(tons)

Year	N.S.W.	Q'land	S. Aust.	W. Aust.	Tas.	Australia
1959	12.47	12.50	10.36	7.64	10.47	11.08
1960	22.15	10.96	12.46	8.01	9.38	13.79
1961	22.29	11.43	14.91	9.63	10.79	14.60
1962	22.42	10.42	19.78	10.32	10.89	15.97
1963	18.86	15.43	21.91	12.52	6.81	18.17

7. **Mine Production of Brown Coal.**—The only production of brown coal in Australia is from Victoria, and production in recent years has been as follows:—1960, 14,967,202 tons; 1961, 16,279,168 tons; 1962, 17,137,436 tons; 1963, 18,456,838 tons; and 1964, a record of 19,033,000 tons. In the past ten years the output of brown coal has nearly doubled, and further increases are expected in the future as electricity generation projects proceed. Approximately 95 per cent. of brown coal production is from the State Electricity Commission's mines in the Latrobe Valley and the bulk of the brown coal is used in electricity generation.

8. **Value at the Mine in New South Wales.**—Particulars of the average values at the mine (or at screens or mine washeries where these are at a distance from the mine) of saleable coal for each district and for New South Wales as a whole are shown in the following table for the years 1959 to 1963. Saleable coal excludes miners' coal, coal consumed at the mines, and refuse, etc., removed by the use of hand-picking belts or at mine washeries. In calculating these values, most coal won by producer consumers is also excluded, and in respect of stocks of coal held at grass by the Commonwealth Government only actual sales have been taken into account. No deduction has been made in respect of excise duty operative from 1st November, 1949.

**AVERAGE SELLING VALUE AT THE MINE PER TON OF SALEABLE COAL:
NEW SOUTH WALES**

(s. d.)

Year	Northern District	Southern District	Western District	Average for State
1959.. .. .	52 5	54 4	47 6	52 7
1960.. .. .	51 11	55 11	48 1	52 8
1961.. .. .	51 5	55 1	46 9	52 3
1962.. .. .	51 3	52 9	44 4	51 2
1963.. .. .	48 7	52 3	39 3	48 11

9. **Values in New South Wales, United Kingdom and the United States of America.**—The following table shows for the years 1959 to 1963 average values of coal produced in New South Wales, Great Britain and the United States of America. The figures give an indication of changes in average value or price within each country, but they do not necessarily show the relative levels between the countries concerned.

PRODUCTION VALUES OF COAL PER TON: NEW SOUTH WALES, UNITED KINGDOM AND UNITED STATES OF AMERICA

Country	1959	1960	1961	1962	1963
New South Wales—bituminous(a) ..	s. d. 52 7	s. d. 52 8	s. d. 52 3	s. d. 51 2	s. d. 48 11
United Kingdom—deep-mined(b) ..	83 5	86 1	90 10	91 9	91 8
United States of America— bituminous and lignite(c)	\$ 4.77	\$ 4.69	\$ 4.58	\$ 4.48	\$ 4.39

(a) Average selling value at the mine per ton of 2,240 lb.; the figures relate to saleable coal and include excise duty. (b) Average value in sterling at the mine per ton of 2,240 lb. (c) Average value in United States currency at the mine per ton of 2,000 lb.

10. Consumption of Coal in Australia.—(i) *Black Coal*. Details of the production of black coal in Australia and its disposal are shown in the following table for the years 1959–60 to 1963–64.

BLACK COAL: PRODUCTION AND CONSUMPTION

('000 tons)

Particulars	1959–60	1960–61	1961–62	1962–63	1963–64
Production	21,223	22,947	24,427	24,301	26,872
Imports(a)	8	7	5	8	13
Total	21,231	22,954	24,432	24,309	26,885
Consumption as fuel—					
Electricity generation ..	7,398	7,420	7,869	8,293	9,066
Factories	3,166	3,103	2,844	2,779	2,894
Railway locomotives ..	2,031	1,885	1,653	1,542	1,454
Bunker coal(b)	176	151	126	123	150
Total	12,771	12,559	12,492	12,737	13,564
Consumption as raw material—					
For metallurgical coke ..	4,216	4,910	5,039	5,195	5,608
For other purposes	1,776	1,751	1,631	1,473	1,580
Total	5,992	6,661	6,670	6,668	7,188
Exports (oversea)	1,088	1,888	3,470	2,677	3,806
Mine washery refuse and dump losses(c)	982	1,072	1,341	1,278	1,584
Balance—unrecorded consumption, other purposes(d) ..	398	774	459	949	743
Grand Total	21,231	22,954	24,432	24,309	26,885

(a) For special purposes, interstate and intrastate vessels. Later figures include Tasmania. (b) Figures refer only to New South Wales coal consumed by oversea. (c) Prior to 1959–60, figures refer only to New South Wales. (d) Includes net change in stocks.

(ii) *Brown Coal*. The table following shows the production and consumption of brown coal and the production of briquettes in Victoria for the years 1959–60 to 1963–64.

BROWN COAL: PRODUCTION AND CONSUMPTION, VICTORIA

('000 tons)

Particulars	1959–60	1960–61	1961–62	1962–63	1963–64	
Production	14,101	15,723	16,729	17,766	18,683	
Consumption as fuel—						
Electricity generation ..	} 10,498	9,970	10,981	{ 11,333	12,029	
Briquette factory						535
Other factories						894
1,248	951	860	894	894		
Consumption as raw material—						
Briquette manufacture ..	2,396	4,764	4,862	4,980	5,192	
Balance(a)	-41	+38	+26	+24	+30	
Briquettes manufactured ..	975	1,807	1,820	1,805	1,88	

(a) The sign (+) indicates that the balance shown is available for other consumption and accumulation of stocks; the sign (-) indicates a reduction in stocks.

The State Electricity Commission of Victoria produces brown coal briquettes at Yallourn and Morwell, both situated on the brown coal deposits in Gippsland. The former commenced commercial production of briquettes in 1925, and initial output of the Morwell plant was in 1960.

In December, 1956, the Lurgi high pressure brown coal gasification plant at Morwell was opened by the Gas and Fuel Corporation of Victoria. This plant operates on briquettes supplied by belt conveyor from the State Electricity Commission's Morwell works, and produces town gas which is sent to Melbourne through 103 miles of pipeline.

11. **Exports.**—The quantities and values of the oversea exports of Australian coal and of bunker coal for oversea vessels for the five years 1959–60 to 1963–64 are shown in the following table. These shipments were made mainly from New South Wales ports.

COAL: OVERSEA EXPORTS AND BUNKER, AUSTRALIA

Year	Oversea exports(a)		Bunker coal for oversea vessels	
	Quantity	Value	Quantity	Value
	Tons	£	Tons	£
1959–60	1,087,844	4,326,810	8,117	25,380
1960–61	1,888,415	7,682,223	179	1,716
1961–62	3,469,552	13,611,122	37	410
1962–63	2,676,522	11,170,712	1,703	17,578
1963–64	3,805,747	16,230,845	86	1,162

(a) Excludes bunker coal.

New South Wales, in addition to meeting requirements within the State, supplies considerable quantities of coal to other States and for export overseas. Of the total of 20,416,000 tons produced in 1963–64, 1,142,000 tons (5.6 per cent.) were exported interstate and 2,995,000 tons (14.7 per cent.) were exported overseas. In 1963–64, 143,000 tons (0.7 per cent.) of New South Wales production was supplied for interstate, intrastate and oversea vessels.

12. **Production in Principal Countries.**—The following table shows the production of coal in the six principal countries and Australia and estimated world totals in 1962 and 1963.

COAL: MINE PRODUCTION IN SELECTED COUNTRIES

(Source: *Minerals Yearbook*, United States Department of the Interior)
(^{'000 tons})

Country	Black coal		Brown coal and lignite	
	1962	1963	1962	1963
United States of America	389,275	423,652	2,728	2,420
U.S.S.R.	375,966	383,840	132,868	137,788
China (Mainland)	(a) 375,000	(a) 267,957	(b)	(b)
United Kingdom	197,388	195,796	..	..
Germany, Federal Republic of	141,392	149,871	99,652	104,972
Poland	107,873	111,303	10,916	15,101
Australia	24,470	24,856	17,137	18,456
World Total(c)	1,959,197	1,901,773	677,621	710,755

(a) Includes lignite.

(b) Included with black coal.

(c) Estimated.

13. **Coke and Other By-products from Coal.**—(i) *Coke.* The production of metallurgical coke in Australia during 1963–64 was 2,915,005 tons, compared with 2,759,060 tons during 1962–63.

In addition to metallurgical coke referred to on page 1178 (produced by specialized coke works), considerable quantities of coke are produced in gas works as a by-product of the manufacture of gas. Production in gas works in 1963-64 was 693,361 tons. To date there has been no production of petroleum coke at Australian oil refineries.

In order to avoid duplication with coal values the figures for coke have not been included in the general tables of mineral production in the early part of this chapter.

In the following table particulars of the production of coke in coke works and gas works in Australia are shown for the years 1959-60 to 1963-64. The figures exclude output of coke breeze, which amounted to 379,183 tons in 1962-63 and 417,949 tons in 1963-64.

COKE PRODUCTION: AUSTRALIA
(tons)

Industry	1959-60	1960-61	1961-62	1962-63	1963-64
Coke works	2,376,097	2,738,505	2,716,894	2,759,060	2,915,005
Gas works	758,668	764,626	761,355	694,575	693,361
Total	3,134,765	3,503,131	3,478,249	3,453,635	3,608,366

(ii) *Other By-products from Coal.* In addition to coke, other products are obtained from the treatment of coal by coke and gas works. Some of the main items produced, principally in coke and gas works, during 1963-64 (1962-63 in parentheses) were: crude tar, 54,543,779 gallons (53,886,802 gallons); refined tar, 41,707,005 gallons (38,514,896 gallons); and ammonium sulphate, 85,488 tons (93,675 tons).

§ 15. Petroleum Exploration and Development in Australia

1. **Introduction.**—A comprehensive survey of developments in the search for oil up to the end of 1961 and early 1962 was presented on pages 1094-8 of Year Book No. 48 and continued in subsequent issues. A summary of developments in 1964 is given below.

2. **Developments in 1964.**—The year 1964 saw the entry of Australia into the ranks of the oil-producing countries. On 25th March, 1964, full scale pumping of oil from the Moonie field to Brisbane was started through the ten-inch Moonie-Brisbane pipeline. Production from the Moonie field is about 6,000 barrels a day (a barrel contains 34.97 gallons).

During 1964 gas fields were established in Queensland at Richmond, Bony Creek, Snake Creek and Pickanjinie near Roma, and at Rolleston. Oil was discovered at Alton, about 55 miles south-west of the Moonie field. In the Alton field all wells drilled so far have been completed as potential oil producers. Elsewhere, potential gas fields have been discovered at Gidgealpa in the north-east of South Australia, at Gilmore about 115 miles north-west of Charleville, Queensland, and at Mereenie about 140 miles west of Alice Springs in the Northern Territory. In Western Australia oil has been discovered on Barrow Island, 60 miles north-east of Onslow and gas has been found at Yardarino about eight miles east of Dongara. A map of Australia showing the main sedimentary basins and locations of oil and gas discoveries appears on page 1189.

During 1964 the combined expenditure on petroleum exploration and development by private enterprise and the Government was £25 million. Total expenditure to date on petroleum exploration and development is in the order of £150 million.

3. **Footage Drilled in the Search for Oil.**—The following table shows details of footage drilled in the petroleum exploration and development in Australia and Papua and New Guinea during the years 1960 to 1964.

**FOOTAGE DRILLED IN PETROLEUM EXPLORATION AND DEVELOPMENT
IN AUSTRALIA, PAPUA AND NEW GUINEA**

(Source: Bureau of Mineral Resources(a))

(feet)

State or Territory	1960	1961	1962	1963	1964
New South Wales	6,169	7,779	34,031	70,798	60,888
Victoria	14,682	22,439	42,635	28,028	41,595
Queensland	52,508	74,931	237,315	434,113	744,662
South Australia .. .. .	..	8,945	40,836	65,956	83,959
Western Australia	14,003	13,712	38,400	41,423	99,972
Northern Territory	1,373	1,024	9,347	18,967	29,866
Australia	88,735	128,830	402,564	659,285	1,060,942
Papua and New Guinea	10,294	..	5,947	4,657	4,249

(a) Based on figures obtained from State Departments of Mines and the Northern Territory Mines Branch.

§ 16. Sulphur

1. **Mine Production.**—There is no production of elemental sulphur (brimstone) in Australia. However, while sulphur is itself non-metallic, considerable quantities are contained in certain metallic minerals produced. Large quantities of the lead and zinc concentrates produced are exported, and the sulphur they contain is not available for utilization in Australia.

The following table shows the sulphur content of the metallic minerals from which sulphur was subsequently recovered during 1963.

SULPHUR: CONTENT OF METALLIC MINERALS PRODUCED, 1963

(tons)

Mineral in which contained	N.S.W.	Q'land	S. Aust.	W. Aust.	Tas.	Australia
Lead concentrate ..	64,695	..	..	26	3,360	68,081
Lead-copper concentrate ..	..	..	..	..	2,624	2,624
Pyrite concentrate ..	..	17,010	32,813	25,226	9,537	84,586
Zinc concentrate ..	148,017	15,531	..	..	26,797	190,345
Total ..	212,712	32,541	32,813	25,252	42,318	345,636

The principal producing centres during 1963 were as follows.

New South Wales. All the sulphur produced was contained in lead and zinc concentrates produced at Broken Hill.

Tasmania. A pyrite concentrate was produced at Mount Lyell after the separation of the copper sulphide mineral. Recoverable sulphur was contained also in lead, lead-copper and zinc concentrates milled at Rosebery, but only that contained in zinc concentrate was recovered in Australia.

The following table shows for the years 1959 to 1963 the sulphur content of minerals from which sulphur was recovered.

SULPHUR: CONTENT OF METALLIC MINERALS PRODUCED

(tons)

State	1959	1960	1961	1962	1963
New South Wales	188,892	204,358	194,659	196,793	212,712
Queensland	17,464	24,612	20,515	27,151	32,542
South Australia	27,616	31,717	33,357	29,092	32,813
Western Australia	24,473	24,556	24,046	23,209	25,251
Tasmania	52,100	54,757	52,289	36,558	42,318
Australia	310,545	340,000	324,866	312,803	345,636

2. Production of Sulphuric Acid.—The principal use of sulphur is in the manufacture of sulphuric acid, which is produced in all States and in the Northern Territory. Most of the sulphuric acid is used for fertilizer manufacture, although small quantities are used in chemicals (including agricultural chemicals) and in metallurgy. Sulphur contained in lead concentrate is used for acid manufacture at Port Pirie and at Cockle Creek and sulphur in zinc concentrate is used at Risdon and also at Cockle Creek. Pyrite concentrate is used as a source of sulphur for acid manufacture at Cockle Creek, and at Melbourne, Brisbane, Adelaide, Perth and Fremantle. However, about half the sulphuric acid produced in Australia is made from imported elemental sulphur. The next table shows, for the years 1960 to 1964, the Australian production of sulphuric acid and the quantity of sulphur in the acid produced from various sources.

SULPHUR USED IN SULPHURIC ACID PRODUCTION: AUSTRALIA

(tons)

Item	1960	1961	1962	1963	1964
Production of sulphuric acid (mono)	1,109,751	1,137,501	1,229,256	1,315,562	1,542,606
Sulphur in sulphuric acid (mono) produced from—					
Sulphur (elemental)(a) ..	179,752	182,554	202,659	212,208	284,436
Zinc concentrate ..	42,946	52,423	65,342	72,059	85,448
Lead concentrate ..	21,573	22,440	20,247	24,643	27,221
Pyrite ..	104,406	100,520	97,927	108,692	99,897
Spent oxide ..	3,814	2,277	2,381	132	1,666
Other materials ..	10,396	11,749	13,410	12,455	5,040
Total Sulphur Content	362,887	371,963	401,966	430,189	503,708

(a) All imported.

§ 17. Non-metallic Minerals

1. **Asbestos.**—Production of asbestos has been confined mainly to crocidolite in Western Australia, principally at Wittenoom Gorge in the north-western part of the State. Deposits of chrysotile, located mainly at Nunyerry in Western Australia and at Baryulgil in New South Wales, are relatively small and widely scattered.

The production of chrysotile and crocidolite in Australia during the five years 1959 to 1963 is shown in the following table.

PRODUCTION OF ASBESTOS

(short tons of 2,000 lb.)

Year	Chrysotile			Crocidolite
	New South Wales	Western Australia	Australia	Australia(a)
1959	726	707	1,433	16,442
1960	1,072	69	1,141	14,472
1961	794	175	969	15,777
1962	866	59	925	17,491
1963	938	11	949	12,425

(a) Wholly produced in Western Australia.

2. **Clays.**—Statistics of clay production in Australia are not entirely satisfactory, mainly because of differences between States in the classification of the various types of clays. In addition, the statistics are incomplete, as some clays are outside the normal administrative control of some State Mines Departments. In the following table, the recorded production of the main types of clays produced in each State of Australia is shown for the year 1963.

PRODUCTION OF CLAYS, 1963

(tons)

Type	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Australia
Bentonite and bentonitic clay ..	..	..	331	..	1,197	..	1,528
Brick clay and shale	1,987,381	1,345,427	222,651	407,247	439,419	146,885	4,549,010
Cement clay and shale ..	189,974	..	..	12,979	18,772	..	221,725
Damouritic clay ..	..	..	..	492	..	..	492
Fireclay, n.e.i. ..	104,578	31,913	13,998	29,544	25,002	..	205,035
Fuller's earth ..	70	..	..	..	..	..	70
Kaolin ..	27,161	12,462	168	3,833	920	..	44,544
Stoneware clay ..	94,849	94,315	37,009	34,743	..	..	(a)260,916
Tile clay ..	88,649	64,972	n.a.	..	..	1,875	(a)155,496
Other clays ..	142	..	(b) 53,531	..	16,110	24,229	(a) 94,012

(a) Incomplete, see § 2, para. 1. Scope of Statistics, p. 1138.

(b) Includes tile clays.

3. **Gypsum.**—There are very extensive deposits of gypsum in Australia, but only the more accessible and easily worked deposits have been exploited. These deposits lie in four main regions, (a) in New South Wales stretching from around Griffith to near Broken Hill, (b) in the north-west corner of Victoria, the south-west corner of New South Wales and adjoining parts of South Australia, (c) in South Australia on both sides of St. Vincent Gulf and extending to Lake MacDonnell in the west, and (d) between Perth and Kalgoorlie in Western Australia. The South Australian deposits are the most important, and more than 70 per cent. of the total Australian production of gypsum in 1963 came from that State, where the main centres of production are Kangaroo Island, Stenhouse Bay and Lake MacDonnell.

The building industry is the main user of the gypsum produced in Australia. The greatest part is used in the manufacture of plaster and most of the remainder in cement manufacture. A small amount is also used as fertilizer. A considerable quantity is exported, mainly to New Zealand for use in the plaster industry. Substantial quantities of gypsum are also exported to Japan, Malaysia and the Philippines.

The production of gypsum in Australia is set out in the following table for the five years 1959 to 1963.

PRODUCTION OF GYPSUM

(tons)

Year	New South Wales	Victoria	South Australia	Western Australia	Australia
1959	101,143	81,101	296,816	37,731	516,791
1960	95,514	100,386	340,762	44,216	580,878
1961	97,250	80,223	387,289	45,145	609,907
1962	71,802	78,728	428,730	51,650	630,910
1963	62,247	114,503	497,886	50,808	725,444

4. **Limestone.**—Limestone is quarried in all States. It is used principally in the manufacture of cement, as a metallurgical flux in the steel industry, in the chemical industry, and in agricultural usages.

The recorded statistics of limestone production in each State of Australia are shown in the following table. Details of limestone produced for use as building or road material are not included.

PRODUCTION OF LIMESTONE(a)

('000 tons)

Year	N.S.W.	Vic.	Q'land	S.A.	W.A.	Tas.	Aust.
1959	2,056	1,120	(b)	1,017	(b)	230	5,305
1960	2,400	1,157	(b)	1,064	(b)	215	5,669
1961	2,576	1,243	(b)	1,105	(b)	204	6,146
1962	2,432	1,214	(b)	1,400	(b)	319	6,415
1963	2,524	1,228	(b)	1,574	(b)	345	6,721

(a) Includes shell and coral.

(b) Not available for publication, included in total for Australia.

5. **Magnesite.**—The major sources of magnesite at present are deposits at Fifield, Thuddungra and Lake Cargelligo in central New South Wales, and at Ravensthorpe in Western Australia. Most of the output of magnesite in Australia is used for refractory purposes, mainly in the steel industry, and small amounts are used in chemical, paper, glass, rubber, and ceramic industries. Approximately 32,000 tons of calcined magnesite were imported during 1963. Particulars of the production of magnesite in each State for the years 1959 to 1963 are set out in the table below.

PRODUCTION OF MAGNESITE

(tons)

Year	New South Wales	Queensland	South Australia	Western Australia	Australia
1959	59,777	..	790	19	60,586
1960	61,668	..	498	..	62,166
1961	88,511	..	659	9,625	98,795
1962	61,672	..	295	224	62,191
1963	49,909	..	542	6,495	56,946

6. **Salt.**—Salt is obtained in Australia from solar evaporation pans and dry salt lakes. Production satisfies local requirements and provides a considerable surplus for export, mainly to Japan.

SALT PRODUCTION

('000 tons)

Particulars	1959	1960	1961	1962	1963
South Australia	358	359	387	390	459
Australian total	468	463	509	536	582

7. **Other Non-metallic Minerals.**—Many other non-metallic minerals were produced in Australia during 1963, the most important being barite, diatomite, dolomite, felspar, gemstones (opals and sapphires), phosphate rock, silica, sillimanite and talc. Smaller quantities of garnet concentrate, foundry loam, lithium ores, mineral pigments, pebbles for grinding, perlite, pyrophyllite, rhodonite and serpentine were also produced. Production figures for the most important non-metallic minerals are given on pages 1145-6.

§ 18. Value of Production

1. **Local Value of Mining and Quarrying Production, 1963.**—The following table shows particulars of the local value of production for individual mining industry groups and quarrying for the year 1963. *These statistics are on an industry basis and not by product.* A more detailed reference to the value of production of mining and quarrying and other industries together with a brief explanation of terms used will be found in Chapter XXX. Miscellaneous.

MINING AND QUARRYING: LOCAL VALUE OF PRODUCTION(a), 1963

(£'000)

Industry	N.S.W.	Vic.	Q'land	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
Metal mining—									
Gold mining ..	6	428	245	..	13,362	..	1,136	..	15,177
Lead-silver-zinc mining ..	27,243	..	25,852	{ ..	(b)	(b)	..	..	53,234
Copper-gold mining ..	30	1	..	{ 1	424	(b)	1,696	..	8,980
Tin mining ..	255	10	1,163	..	405	1,107	40	..	2,980
Mineral sands mining ..	5,562	..	3,004	{ ..	(b)	..	..	..	8,694
Other metal mining ..	75	10	..	{ 5,411	1,981	(b)	1	..	8,691
Total, Metal Mining	33,171	449	30,264	5,412	17,139	8,457	2,873	..	97,765
Fuel mining—									
Black coal mining ..	45,419	295	9,533	1,448	1,985	421	..	..	59,101
Brown coal mining ..	..	8,078	..	..	..	..	..	..	8,078
Other fuel mining ..	..	..	29	..	..	..	..	..	29
Total, Fuel Mining ..	45,419	8,373	9,562	1,448	1,985	421	..	..	67,208
Non-metal (excluding fuel) mining—									
Clays(c) ..	1,340	1,277	87	339	184	54	..	..	3,281
Gypsum ..	128	88	..	592	51	..	..	..	859
Limestone ..	1,416	606	(b)	1,213	(b)	(b)	..	..	4,349
Salt ..	..	(b)	(b)	918	(b)	..	..	..	1,162
Other non-metal (excluding fuel) mining(c) ..	721	(b)	58	1,478	1,119	(b)	..	..	3,394
Total Non-metal (excluding Fuel) Mining ..	3,605	2,120	892	4,540	1,493	395	..	..	13,045
Total, All Mining ..	82,195	10,942	40,718	11,400	20,617	9,273	2,873	..	178,018
Construction material quarrying(c) ..	10,481	9,478	1,324	5,704	1,767	879	367	323	30,323
Total, All Mining and Quarrying ..	92,676	20,420	42,042	17,104	22,384	10,152	3,240	323	208,341

(a) Value of output or selling value of products at the mine or quarry. (b) Not available for publication, included in total for Australia. (c) Incomplete; see § 2, para. 1. Scope of Statistics, p. 1138.

2. Local Values, 1959 to 1963.—In the following table the local value of mining and quarrying production is shown by States and Territories.

MINING AND QUARRYING: LOCAL VALUE OF PRODUCTION(a)

(£'000)

Year	N.S.W.	Vic.	Q'land	S. Aust.	W. Aust.	Tas.	N.T. and A.C.T.	Aust.
1959 ..	71,090	14,935	33,329	13,209	21,787	7,639	2,996	164,985
1960 ..	79,641	16,267	37,608	13,952	22,166	8,067	3,539	181,240
1961 ..	78,171	b 20,027	32,220	15,912	22,496	7,959	3,366	180,151
1962 ..	79,964	b 20,008	37,099	15,387	23,245	8,903	2,963	187,569
1963 ..	92,676	b 20,420	42,042	17,104	22,384	10,152	3,563	208,341

(a) Value of output or selling value of products at the mine or quarry. (b) Not comparable with years prior to 1961 owing to extension of coverage of quarrying activities.

3. Net Value of Mining and Quarrying Production.—The following table shows particulars of the net value of production for individual mining industry groups and construction material quarrying for the year 1963.

MINING AND QUARRYING: NET VALUE OF PRODUCTION(a), 1963
(£'000)

Industry	N.S.W.	Vic.	Q'land	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
Metal mining—									
Gold mining	3	(b)	(b)	..	8,854	..	966	..	10,298
Lead-silver-zinc mining	22,638	..	(b)	..	1	(b)	..	..	42,439
Copper-gold mining ..	21	..	(b)	(b)	253	(b)	1,295	..	5,373
Tin mining	212	9	883	..	289	804	29	..	2,226
Mineral sands mining ..	4,159	..	(b)	..	(b)	..	..	..	6,168
Other metal mining ..	65	(b)	(b)	(b)	1,530	(b)	1	..	7,266
Total, Metal Mining	27,098	310	21,926	(b)	(b)	5,878	2,291	..	73,770
Fuel mining—									
Black coal mining ..	34,483	209	(c) 7,760	(b)	(b)	343	..	..	d 45,629
Brown coal mining ..	..	7,339	..	..	..	..	..	..	7,339
Total, Fuel Mining ..	34,483	7,548	(c) 7,760	(b)	(b)	343	..	..	d 52,968
Non-metal (excluding fuel) mining—									
Clays(e)	1,053	1,198	73	309	130	47	..	..	2,810
Gypsum	92	69	..	(b)	(b)	..	..	..	690
Limestone	1,029	378	(b)	1,052	(b)	(b)	..	..	3,204
Salt .. ..	..	(b)	(b)	757	(b)	..	..	..	(f) 978
Other non-metal (excluding fuel) mining (e)	619	(b)	50	(b)	(b)	(b)	..	..	2,596
Total, Non-metal (excluding Fuel) Mining ..	2,793	1,794	571	3,986	822	312	..	..	10,278
Total, All Mining ..	64,374	9,652	30,257	9,879	14,030	6,533	2,291	..	137,016
Construction material quarrying(e) ..	10,481	7,174	717	4,928	1,319	700	252	211	25,782
Total, All Mining and Quarrying ..	74,855	16,826	30,974	14,807	15,349	7,233	2,543	211	162,798

(a) Local value (i.e. value of output at mine or quarry) less cost of power, fuel, light and other materials and stores used; depreciation and maintenance costs have not been deducted. (b) Not available for publication, included in total for Australia. (c) Includes other fuel mining. (d) Includes other fuel mining in Queensland. (e) Incomplete; see §2, para. 1. Scope of Statistics, p. 1138. (f) No allowance has been made for cost of power, fuel, light and materials and stores used by the salt industry in Victoria as particulars are not available.

4. Net Value of Production, 1959 to 1963.—In the following table the net value of mining and quarrying production and the value per head of population are shown by States and Territories.

MINING AND QUARRYING: NET VALUE OF PRODUCTION(a)

Year	N.S.W.	Vic.	Q'land	S.A.	W.A.	Tas.	N.T. and A.C.T.	Aust.
NET VALUE OF PRODUCTION (£'000)								
1959	56,331	12,101	24,481	10,698	14,765	5,398	2,381	126,155
1960	63,214	13,158	27,460	11,404	15,444	5,476	2,871	139,027
1961	60,684	(b)16,479	23,434	13,103	15,553	5,203	2,789	137,245
1962	62,609	(b)16,197	29,003	13,207	16,122	6,117	2,259	145,514
1963	74,855	(b)16,826	30,974	14,807	15,349	7,233	2,754	162,798

NET VALUE OF PRODUCTION PER HEAD OF POPULATION
(£)

1959	14.8	4.3	16.6	11.5	20.6	15.7	31.9	12.4
1960	16.3	4.5	18.3	11.9	21.2	15.6	35.5	13.4
1961	15.4	(b) 5.6	15.4	13.4	20.9	14.6	31.4	13.0
1962	15.6	(b) 5.4	18.7	13.2	21.1	16.9	23.3	13.5
1963	18.3	(b) 5.4	19.7	14.5	19.6	19.8	25.7	14.8

(a) Local value i.e. value of output at mine or quarry, less cost of power, fuel, light and other materials and stores used; depreciation and maintenance costs have not been deducted. (b) Not comparable with years prior to 1961 owing to extension of coverage of quarrying activities.

5. Local Value of Minerals Produced, 1959 to 1963.—Particulars of the values of minerals (mine and quarry products) produced are shown in the following table. The values represent the selling value at the mine or quarry of minerals produced during the years concerned.

LOCAL VALUE OF MINERALS PRODUCED: AUSTRALIA
(£'000)

Mineral	1959	1960	1961	1962	1963
METALLIC MINERALS					
Copper ore, concentrate, etc.	21,165	25,439	21,249	24,302	25,338
Gold ore, concentrate, other forms, etc.	15,853	15,870	15,859	15,627	14,062
Iron ore	4,633	4,844	5,899	5,325	6,100
Lead and lead-silver ore and concentrate, lead-copper concentrate, etc.	21,477	20,396	16,933	19,548	28,160
Manganese ore	626	329	427	480	246
Pyritic concentrate	1,068	1,136	1,252	1,115	778
Rutile concentrate	3,838	3,639	3,314	3,519	5,781
Tin concentrate	2,043	1,940	2,786	2,834	2,892
Tungsten concentrates	410	940	1,033	599	820
Zinc ore and concentrate	4,888	7,730	5,295	4,555	8,234
Zircon concentrate	1,008	972	1,267	1,291	1,775
Other metallic minerals	512	575	769	947	3,568
<i>Total, Metallic Minerals</i>	<i>77,521</i>	<i>83,810</i>	<i>76,083</i>	<i>80,102</i>	<i>97,754</i>
FUEL MINERALS					
Coal, black	49,211	55,201	57,081	59,539	59,101
Coal, brown	6,123	6,845	7,722	7,841	8,078
Other fuel minerals .. ..	..	..	n.a.	n.a.	29
<i>Total, Fuel Minerals</i>	<i>55,334</i>	<i>62,046</i>	<i>64,803</i>	<i>67,380</i>	<i>67,208</i>
NON-METALLIC (EXCLUDING FUEL) MINERALS					
<i>Total, Non-metallic (excluding Fuel) Minerals</i>	<i>10,533</i>	<i>10,843</i>	<i>11,494</i>	<i>12,160</i>	<i>13,019</i>

NOTE.—For footnotes see next page.

LOCAL VALUE OF MINERALS PRODUCED: AUSTRALIA—*continued*
(£'000)

Mineral	1959	1960	1961	1962	1963
CONSTRUCTION MATERIALS(a)					
Total, Construction Materials	21,597	24,541	(b) 27,771	(b) 27,927	(b) 30,360
TOTAL					
Total, All Minerals and Construction Materials	164,985	181,240	180,151	187,569	208,341

(a) Incomplete owing to difficulties of coverage. See § 2, para. 1. Scope of Statistics, p. 1138.
(b) Not comparable with years prior to 1961 owing to extension of coverage in Victoria.

NOTE.—Particulars of the value of uranium concentrate produced are not available for publication and have been excluded from the table above.

Owing to the necessity of classifying individual mines according to the principal mineral produced, the values in the table on page 1185 for mining industry groups differ slightly in some cases from totals of the corresponding groups of mine products shown in the table above.

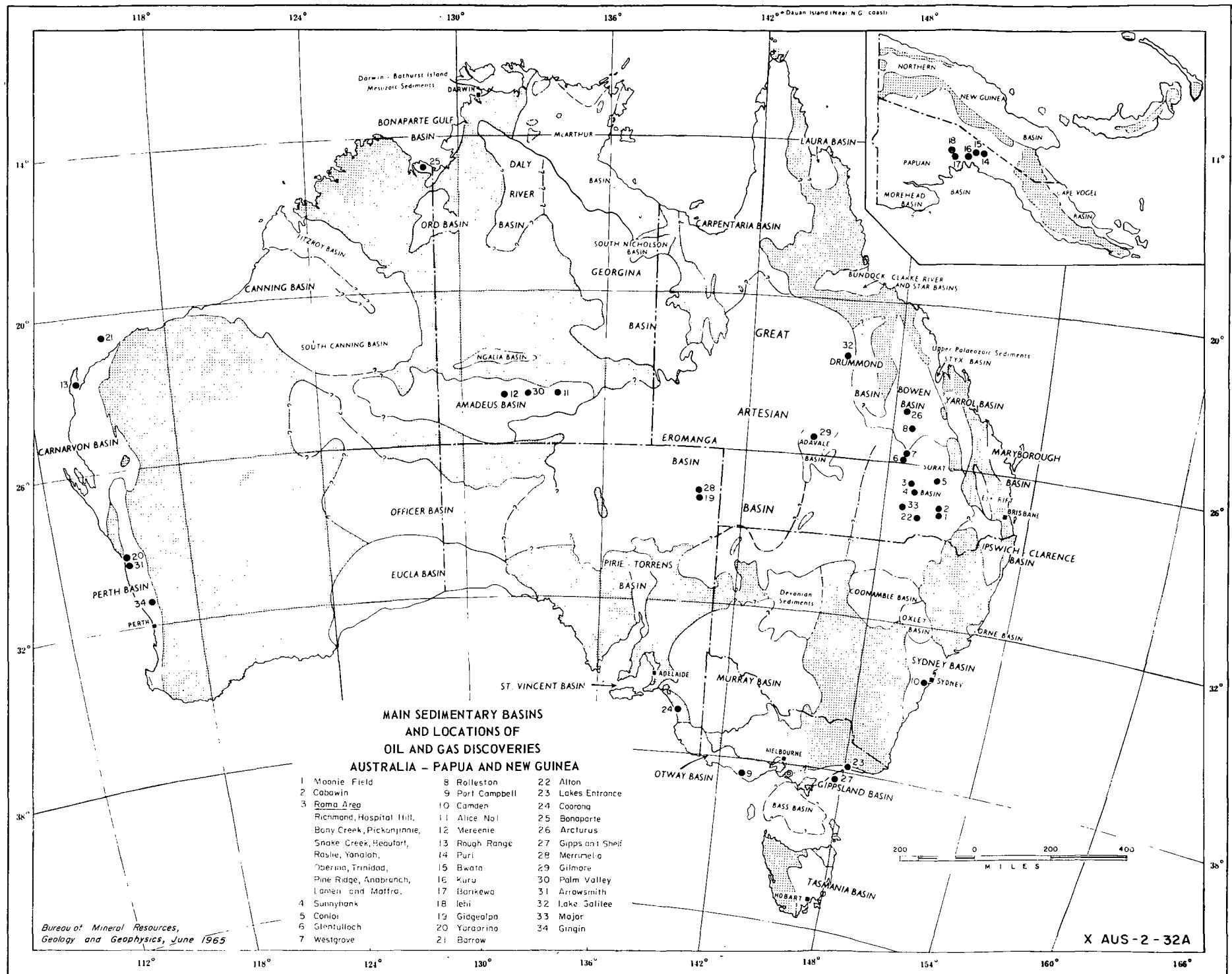
§ 19. Oversea Trade in Minerals and Mineral Products

Particulars of the quantity and value (£A. f.o.b. port of shipment) of the principal mineral and mineral product items imported into and exported from Australia during the years 1961 to 1963 are shown in the following table.

IMPORTS AND EXPORTS OF PRINCIPAL MINERALS AND MINERAL PRODUCTS: AUSTRALIA

Item	Quantity			Value (£A.'000 f.o.b.)		
	1961	1962	1963	1961	1962	1963
IMPORTS						
Alumina tons	(a)	(a)	54,486	(a)	(a)	1,825
Aluminium, refined ingots	16,141	31,389	12,115	3,883	7,443	2,764
Asbestos short tons	36,901	39,105	36,628	2,310	2,437	2,106
Gold, unrefined bullion(b) fine oz.	146,278	132,957	161,849	2,283	2,074	2,525
Ferro-alloys tons	55,959	16,218	28,878	4,195	1,296	2,488
Petroleum oils—						
Crude '000 gals.	2,837,372	2,976,789	3,286,617	66,455	66,675	74,160
Enriched crude "	404,861	411,683	572,164	11,831	11,692	13,728
Kerosenes "	110,906	103,176	89,231	5,673	5,403	4,838
Lubricating oil "	50,117	52,296	53,524	7,208	7,216	7,385
Gasolenes and solvents "	190,245	234,186	253,934	10,284	13,093	14,192
Phosphate rock '000 tons	1,766	1,721	1,762	4,768	4,484	5,354
Sulphur tons	182,052	229,195	222,527	1,920	2,389	3,152
Tim, refined "	778	1,778	1,751	836	1,993	1,862
Titanium oxide (pigments)	5,139	5,947	5,086	1,017	1,144	1,006

NOTE.—For footnotes see next page.



IMPORTS AND EXPORTS OF PRINCIPAL MINERALS AND MINERAL PRODUCTS: AUSTRALIA—*continued*

Item	Quantity			Value (£A.'000 f.o.b.)		
	1961	1962	1963	1961	1962	1963
EXPORTS(c)						
Coal tons	2,850,307	2,909,169	3,174,773	11,505	11,694	13,337
Copper—						
Ore and concentrate "	107,234	78,983	30,937	6,470	4,984	2,051
Ingots, pigs (refined) "	23,073	16,497	24,698	6,698	4,827	7,064
Rolled, drawn and extruded shapes "						
tons	2,029	3,270	5,049	769	1,188	1,907
Gold, refined fine oz.	1,099,701	314,996	472,132	17,265	4,932	7,389
Iron and steel—						
Pig iron tons	296,050	157,502	132,798	6,588	3,514	2,645
Ingots, blooms and slabs "	86,860	97,950	31,899	3,102	3,210	1,028
Tinplate "	16,644	25,238	68,200	1,338	2,134	4,767
Scrap "	223,320	138,977	334,351	3,957	1,967	3,965
Lead—						
Ore and concentrate(d) "	86,268	109,058	121,983	4,590	5,596	6,714
Lead-silver bullion "	46,089	76,014	76,482	4,476	6,212	6,693
Pig "	145,174	197,049	174,988	11,382	13,199	13,244
Opals .. .. . "	..	..	..	1,404	2,106	2,697
Petroleum oils—						
Gasolenes and solvents ..'000 gals.	63,214	32,073	51,752	3,635	2,131	2,867
Kerosenes "	43,464	20,710	25,327	2,438	1,254	1,552
Automotive distillate "	139,311	165,262	123,656	6,884	8,288	6,289
Residuals and heavy distillates "	238,318	350,661	384,816	8,096	10,376	11,551
Rutile concentrate tons	99,652	117,291	154,508	3,207	3,629	5,316
Zinc—						
Ore and concentrate "	276,109	255,209	260,421	5,056	4,072	4,366
Refinery type shapes "	46,472	91,215	96,755	4,482	7,459	8,557
Zircon concentrate "	140,333	131,843	179,697	1,723	1,645	2,177

(a) Not recorded separately. (b) Includes gold contained in matte. (c) Includes re-exports.
 (d) Includes lead-copper concentrate.

Considerable quantities of metallic ores, concentrates, slags and residues are exported from Australia for refining overseas. The following table shows the quantities of such items exported during 1963 and their principal metallic content as estimated by assay.

**PRINCIPAL METALLIC CONTENTS OF SPECIFIED ORES AND CONCENTRATES,
ETC., EXPORTED FROM AUSTRALIA DURING 1963**

Ores and concentrates, etc.	Quantity exported	Metallic contents—estimated from assay						
		Copper	Gold	Lead	Silver	Tin	Tungstic oxide	Zinc
		tons	tons	fine oz.	tons	fine oz.	tons	tons
Copper—								
Ore and concentrate ..	30,937	7,330	23,078	..	156,175	5	..	..
Copper-lead dross and speiss	5,763	844	..	3,970	355,572	..	..	..
Other slags and residues	6,618	1,379	3,831	3	17,115	17	..	5
Blister	464	461	278	..	2,041	..	..	..
Matte	502	220	5	..	167	14,779	..	..
Precipitate	1,417	739	..	..	..	..	..	..
Lead—								
Ore and concentrate(a)	121,983	1,278	23,491	85,613	2,301,530	..	..	7,117
Slags and residues ..	2,896	90	..	1,099	6,812	73	..	29
Lead-silver bullion ..	76,482	..	..	75,994	5,122,294	..	..	..
Tin concentrate	91	..	..	..	..	44	..	..
Tungsten—								
Scheelite ore and con- centrate	739	..	..	..	..	..	513	..
Wolfram ore and con- centrate	337	..	..	..	..	..	242	..
Zinc—								
Ore and concentrate ..	260,421	..	..	1,993	124,612	..	..	133,495
Slags and residues ..	5,793	..	..	..	..	..	..	4,236
Total Metallic Con- tents .. ..	..	12,341	50,683	168,839	8,100,930	139	755	144,882

(a) Includes lead-copper concentrate.