THE MINERAL INDUSTRY OF

INDIA

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The Republic of India consists of 25 States and 7 Union territories and covers a land area slightly more than one-third that of the United States. The country has rich and varied mineral resources and a long history of mining and mineral processing. India produces a wide array of industrial, metallic, and fuel minerals. The country is richly endowed with such minerals as bauxite, chromite, dolomite, steaming coal, iron ore, limestone, and manganese—raw materials for the manufacture of aluminum, cement, and steel. India, however, continued to be a net importer of a number of mineral commodities, including asbestos, coking coal, copper, diamond, gold, lead, molybdenum, nickel, petroleum, phosphate rock, potash, sulfur, tungsten, and zinc. The total value of mineral production in India was estimated to be $9.5 billion, approximately 3.5% of the country's gross domestic product (KPMG, August 1997, Focus on India—Mining, accessed April 9, 1998, at URL http://www.aspac.kpmg.com/asiasphere/97-aug/focus_on_india.htm).

The mineral policy of India evolved mainly from the Industrial Policy Resolution of 1956, which stipulated, for example, the policies pertaining to the mining industry. In August 1990, a distinct National Mineral Policy with well-defined objectives was enacted. The policy designated the central Government as the entity responsible for developing, mining, and processing the 13 minerals (chromite, copper, diamond, gold, iron ore, lead, manganese, molybdenum, nickel, platinum-group metals, sulfur, tungsten, and zinc) considered to be of basic and strategic importance to the country; the exploitation of other minerals was left to the private sector.

Following the economic liberalization initiated by the Government in mid-1991, previously Government-controlled sectors, such as the mining, metallurgical, and power-generation industries, were opened fully for private domestic and foreign investment. Concordantly, the National Mineral Policy was revised in 1993, and the 13 minerals previously reserved exclusively for central Government control were released, opening the entire mining sector to private investment by domestic and foreign companies (Tandon, 1998, p. 2).

Mining in India is regulated under the Mines and Minerals (Regulation and Development) Act, 1957, as modified. Under this Act, all minerals are owned by the constituent States but are administered by the central Government. Although set and revised by the central Government, mining royalties and taxes are paid directly to the individual States.

The mining industry is administered by the Ministry of Mines, which is responsible for geologic surveys, exploration, and administration of the Mines and Minerals Act for all minerals except mineral fuels. Coal is administered by the Department of Coal within the Ministry of Energy. The Ministry of Petroleum and Natural Gas has responsibility for exploration and production of oil and natural gas, as well as its refining, distribution, and marketing. Nuclear materials are regulated by the Department of Atomic Energy (DAE). The Geological Survey of India, the Indian Bureau of Mines, and the Controller of Mining Leases are subordinate offices within the Ministry of Mines.

India was a major minerals producer, ranking among the world's leading producers of bauxite, bituminous coal, iron ore, and zinc. The main mining industry was steaming coal for power generation. Coal provided about 60% of the country's energy requirements. Including peat and lignite, it accounted for an estimated 40% of the value of all mineral production. Iron ore, primarily from surface operations, accounted for an estimated 40% of the value of all metallic mineral production. Approximately 50% was used domestically for steel production, with the balance exported.

Domestic production of copper, lead, and zinc satisfied less than about 45% of the country's requirements, with imports fulfilling the balance. Aluminum was the only nonferrous metal for which an adequate domestic ore (bauxite) resource was available.

The mineral industries of India produced more than 80 mineral commodities, embracing various metal ores, industrial minerals, and mineral fuels. The fuel minerals—coal, lignite, natural gas, and crude petroleum—accounted for about 85% of the total value of mineral production, metallic minerals accounted for about 7% of the value, and industrial minerals and about 20 minor minerals accounted for the remaining 8% (Mining Magazine, 1997). Metallic mineral production comprised mainly chromite-zinc concentrates, copper, gold, iron ore, lead-silver concentrates, and manganese ore. Among the industrial minerals, 90% of the aggregate value was shared by barite, dolomite, fluorite, gypsum, kaolin, limestone, magnesite, mica, and steatite. Limestone, used for cement and steel production, remained the leader in the industrial minerals sector, producing an estimated 70% of the total value of industrial minerals (National Information Centre, November 27, 1995, Mining, accessed December 8, 1997, at URL http://www.nic.in/India-Image/business-profile/doc5/mine.html). An estimated 4,400 mines operated in the country, the vast majority of which were small surface operations using only hand-mining methods and having low output. About 300 underground mines were in production in the nonfuel minerals sector, most of which also were operated manually (Artemis Group Inc., undated, India—Mining, accessed January 22, 1998, at URL http://www.artemisgroupinc.com/mining.htm). Employment in the mineral industry was estimated to have exceeded 1 million people, or about 4.5% of the employed labor force, with the public sector employing about 90% of the total.

In a major bid to speed up the flow of foreign direct investment into the country, the Reserve Bank of India (RBI) relaxed the Foreign Exchange Regulation Act, allowing Indian companies to accept up to 50% equity participation under the RBI's automatic approval route without any prior clearance for operations involved in the mining of bauxite, copper, fertilizer minerals, iron ore, lead,

manganese, mica, rock aggregate, salt, sand and clay, and zinc. Companies will have to report only the issuance of shares to foreign investors by filing the appropriate documents with the RBI (India Weekly Fax Bulletin, 1998). Automatic approval for foreign equity was not available for diamond and other precious and semiprecious gemstones, gold, or silver; applications are required to be submitted to the Foreign Investment Promotion Board. Automatic approval for foreign equity up to 74% is permitted for service industries incidental to mining, such as drilling, shifting, reclamation, and surveying and mapping, excluding services related to gemstones, gold, and silver (Tandon, 1998, p. 3).

India has large resources of bauxite, a major portion of which is in the States of Andhra Pradesh and Orissa. Substantial deposits also occur in the States of Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, and Tamil Nadu (Tandon, 1998, p. 16). India was a significant exporter of alumina, with National Aluminium Co. Ltd. (NALCO) and Indian Aluminium Co. Ltd. (INDAL) together exporting more than 512,000 metric tons per year (t/yr). With an installed capacity of 714,000 t/yr of aluminum output, India has become almost self-sufficient in aluminum production (Mining Journal, 1997b).

Alcan Aluminium Co. Ltd. of Canada and Tata Iron and Steel Co. Ltd. (TISCO) joined with the original three joint-venture partners—INDAL, Tata Industries, and Norway's Norsk Hydro SA—of Utkal Alumina International to establish a 1-million-metric-ton-per-year (Mt/yr) alumina plant at Koraput in Orissa. The project will include a 50-megawatt (MW) cogeneration plant for captive power. The five partners will share equal equity in the $950 million venture, scheduled to be completed in 1998 (Seshadri, 1998).

NALCO started work in September to expand its Dhamanjodi alumina refinery in Orissa from the existing 800,000 t/yr to 1.57 Mt/yr. NALCO's alumina production capacity was expected to reach 1.1 Mt/yr by 2000 and 1.57 Mt/yr by 2002, of which a large part will be available for export or sale to other aluminum smelters within India. About 1.1 million metric tons (Mt) of alumina should be available for sale in 2002, falling to 900,000 metric tons (t) in 2003 as the planned expansion of NALCO's Angul aluminum smelter begins to absorb the excess (Metal Bulletin, 1997f).

In March, the private sector aluminum producer Hindalco Industries Ltd. signed a memorandum of understanding with State-owned Orissa Mining Corp. Ltd. (OMC) to build an integrated aluminum complex in Orissa at an estimated cost of $2.8 billion. The proposed complex will consist of a 1-Mt/yr-capacity alumina refinery and a 250,000-t/yr greenfield aluminum smelter in the Ib Valley of western Orissa. Planning also includes a 600-MW captive powerplant. OMC will lease its Kodingamali-Pottang bauxite deposits to Hindalco, which has set up a new division, Adilya Aluminium, to implement the project (Metal Bulletin, 1997a).

A 3-year, $360 million modernization and expansion program was completed at Hindalco's Renukoot aluminum refinery-smelter in Uttar Pradesh State. The company's alumina capacity rose by 100,000 t, to 450,000 t/yr, while aluminum smelting capacity increased by 32,000 t, to 242,000 t/yr (Metal Bulletin, 1998).

The Indian Cabinet agreed to sell a 40% equity stake in Bharat Aluminium Co. Ltd. (BALCO), a public sector primary aluminum producer with a 100,000-t smelter at Korba, Madhya Pradesh, to a "strategic" partner, with an agreement to dilute Government equity to 26% through a public issue within 2 years. The partner will be required to bring in technology and funding to modernize and expand the BALCO smelter (Metal Bulletin, 1997c).

India was a leading world producer and exporter of chromite. Orissa was the leading producer of chromite in India, both in quality and quantity. Present chromite mining in Sukinda Valley in Orissa reached a depth of 65 meters (m) by opencast methods, and the ore body reportedly continues beyond 200 m in depth (Tandon, 1998, p. 17). The major Indian chromite company is TISCO.

With the exception of the isolated Malanjkhand copper deposit in Madhya Pradesh, the other producing copper mines and most of the identified copper resources occur in the Chitradurga schist belt of Karnataka, the Khetri copper belt, Rajasthan State, and the Singhbhum copper belt, Bihar State. In addition to these major copper belts, smaller copper deposits have been identified in several States (Tandon, 1998, p. 12).

India's State-owned Hindustan Copper Ltd. (HCL) produced a majority of the country's mined copper from 10 mines. HCL also operated the country's only copper smelters-refineries. Important but smaller mines were operated by Sikkim Mining Corp. and Hutti Gold Mines Ltd. in Karnataka. HCL was planning to expand its Khetri copper smelting and refining facility in Rajasthan to 100,000 t/yr of copper at a cost of approximately $125 million. The flash furnace at Khetri had the capacity to increase output from the present 45,000 t/yr to 100,000 t/yr merely by making technical improvements. HCL also was planning to increase its refinery-smelter capacity at Ghatsila from the current 16,500 t/yr to 35,000 t/yr (Mining Journal, 1997b).

Sterlite Industries Ltd.'s new 100,000-t/yr smelter at Tuticorin, Tamil Nadu, was marred by accidents that twice forced the plant's closure in 1997. The smelter was shut down in July after a suspected gas leak and again at the end of August following four suspected bomb blasts that closed the plant for almost 2 months. The smelter was restarted on November 6 at a production rate of 5,000 metric tons per month following repairs to the damage caused by the explosions that killed two people (Metal Bulletin, 1997g). Sterlite was India's only private sector copper smelter.

At yearend, Indo-Gulf Fertilizers and Chemical Corp., a subsidiary of the Birla Group, was nearing completion of its 100,000-t/yr greenfield Birla copper smelter complex on the coast of Gujarat in western India. In addition to the smelter, the site had a continuous cast rod plant of 80,000-t/yr capacity, a sulfuric acid plant of about 300,000-t/yr capacity, a phosphoric acid plant of 100,000 t/yr capacity, and an oxygen plant. The rod mill started up in March using imported cathode, and the smelter began late in 1997 (Metal Bulletin Monthly, 1997a). Indo-Gulf had about 1,600 t of stockpiled copper anode to feed the refinery at startup (Platt's Metals Week, 1998).

India had the largest market for gold in the world. The domestic consumption of gold was estimated to be about 700 t/yr, of which about 200 t/yr was derived from scrap and recycling materials (Tandon, 1998, p. 11). About 80% of India's annual gold demand was used for jewelry—more than one-half of which (350 to 400 t/yr) was used annually for wedding ceremonies (Mining Journal, 1997b).

In an effort to curb smuggling, the Government further liberalized its gold import policy on January 1, 1997, by doubling to 10 kilograms the amount of gold that may be brought into the country by nonresident Indians (Mining Journal, 1997b).

The Karnataka Government shut down the operations of the central Government-owned Bharat Gold Mines Ltd.'s underground mines (Champion Reef, Mysore, and Nundydroog) in the Kolar gold fields

in Kolar district because they were no longer viable concerns. The lack of operating capital, labor problems, and the poor quality of ore that was being extracted from depths of more than 3,000 m hastened the mines' closure (Seshadri, 1998).

India was a major producer of iron ore, which was used to produce steel for domestic use, as well as for export by two State-owned enterprises, the National Mineral Development Corp. Ltd. (NMDC) and the Kudremukh Iron Ore Co. Ltd. (KIOCL). The numerous iron ore mines in the country had an estimated combined capacity of almost 70 Mt/yr.

The country has abundant deposits of hematite and magnetite iron ores. High-grade hematite (greater than 65% iron) occurs mostly in the States of Bihar, Karnataka, Madhya Pradesh, and Orissa; medium-grade hematite (62% to 65% iron) occurs in Goa, as well as in the previous States. Magnetite deposits, most of which are metallurgical in grade, occur in Andhra Pradesh, Goa, Karnataka, and Kerala States (Mining Journal, 1997b).

NMDC operated two of the largest mechanized iron ore mining operations in the country at Bailadila, Madhya Pradesh, and at Donimalai, Karnataka. Their combined output increased to about 18 Mt/yr in midyear. NMDC was planning to open two new ore bodies, 10 and 11A, at Bailadila within the next 2 years to meet an expected increase in iron ore demand (The Hindu, April 22, 1998, NMDC's net profit up, accessed April 28, 1998, at URL http://www.webpage.com/hindu/daily/980422/06/06220003.htm). KIOCL operated the country's largest single mine, the Kudremukh, 110 kilometers (km) east of the southern port city of Mangalore in Karnataka. KIOCL was India's largest 100% export-oriented iron ore company (Ministry of Steel, undated, Kudremukh Iron Ore Co. Ltd., accessed June 10, 1998, at URL http://www.nic.in/steel/LINKE.HTM#LINKB24). Near yearend, Ministry of Finance approved the proposal to sell a 30% share of KIOCL by February 1998 (Metal Bulletin, 1997e).

The country had seven integrated steel plants (ISP) operating in the public sector with a capacity of about 24 Mt/yr of steel ingot. The Government's Steel Authority of India Ltd. (SAIL) owned four ISP, namely Bhilai, Madhya Pradesh; Bokaro, Bihar; Durgapur, West Bengal State; and Rourkela ISP, Orissa. The Burnpur ISP in West Bengal has been owned and operated since 1979 by Indian Iron and Steel Co. Ltd., a wholly owned subsidiary of SAIL, and Visvesvaraya Iron and Steel Ltd.'s ISP at Bhadravati, Karnataka, is a joint venture of SAIL and the Karnataka State Government having 40% and 60% equity stakes, respectively. The Visakhapatnam ISP, more commonly called the Vizag plant, Andhra Pradesh, is owned and operated by the public-sector corporation Rashtriya Ispat Nigam Ltd. (Ministry of Steel, undated, Public Sector Undertakings under Ministry of Steel, accessed June 10, 1998, at URL http://www.nic.in/steel/LINKE.HTM). Only one ISP was in the private sector, that of TISCO's steelworks at Jamshedpur, Bihar. In addition to the ISP, more than 180 electric arc furnaces having a total capacity of about 8.5 Mt/yr were in the country.

Most of India's lead-zinc mines were in the Precambrian shield area in the western part of the country (Tandon, 1998, p. 12). Substantial quantities of lead and zinc were produced from the same mines in the State of Rajasthan by Hindustan Zinc Ltd. (HZL), a public sector company and the country's sole producer of both metals. HZL also mined lead without zinc in the States of Andhra Pradesh and Orissa. HZL operated the country's three primary lead and three of the four primary zinc smelter-refinery complexes; the remaining primary smelter-refinery was operated by Binani Zinc Ltd., a private sector firm producing zinc from imported concentrates. Binani Zinc was expanding its smelter capacity from the current 30,000 t/yr to 60,000 t/yr of zinc; a 20-MW powerplant was to be installed to feed the plant (Metal Bulletin, 1997d).

HZL was planning a $92 million, 100-MW powerplant for its Debari smelter, Udaipur district, Rajasthan, to alleviate recurring power shortages. HZL also was planning to build a 60,000-t/yr zinc smelter to use the increased output resulting from the expansion of its Rampura-Agucha opencast zinc-lead mine from 900,000 t/yr to 1.3 Mt/yr at yearend 1997 (Mining Journal, 1997b).

HZL's Chanderiya lead smelter was not performing very well in midyear because of a high impurity of graphitic carbon in the concentrate produced at the Rampura-Agucha Mine, which was developed along with the smelter as an integrated project. The smelter was using lead concentrates from the Agnigundala, the Sargipali, and the Zawar Mines at yearend (Mining Journal, 1997b).

The private sector Indian Lead Co. was constructing a 20,000-t/yr secondary lead refinery at Wada, about 40 km from its existing 25,000-t/yr refinery at Thane in Mumbai (Bombay), Maharashtra. Indian Lead also was planning to relocate its existing plant from Thane to Wada, thus putting all its lead capacity in the western region at one 45,000-t/yr-capacity site by 1999. Indian Lead also had an 8,000-t-capacity refinery at Kalipark in Calcutta, West Bengal, that used lead scrap, as well as lead ore, as feed (Metal Bulletin, 1997b).

HZL closed its tungsten-zinc operations at Nagaur in northern Rajasthan in midyear because of declining ore grades and high mining costs. HZL had acquired the operation from the Rajasthan State Tungsten Development Corp. (Mining Journal, 1997a).

India was a leading producer and exporter of manganese ore (Tandon, 1998, p. 14). The country's largest manganese ore producer, the Government-owned Manganese Ore India Ltd. (MOIL) was scheduled to commission a 10,000-t/yr ferromanganese furnace at Bharweli, near the company's largest manganese mine at Balaghat, Madhya Pradesh in March 1998. MOIL also was planning to build an 8-MW, oil-based, captive powerplant to serve the new facility and the large underground Balaghat Mine.

Sandur Manganese and Iron Ores Ltd., which also had its own manganese mines, stopped producing ferromanganese at its plant in Karnataka because of the high cost of electricity. Universal Ferro and Allied Chemicals Ltd., previously India's largest manganese alloy producer with a capacity of nearly 100,000 t/yr, had been closed since near yearend 1996 owing to heavy indebtedness to the Maharashtra State Electricity Board (Metal Bulletin Monthly, 1997b).

India was the fourth largest producer of cement in the world with 115 large plants with installed capacity of 96 Mt/yr belonging to 57 companies, 300 minicement plants each with less than 200,000 t/yr capacity a piece, and six white cement plants with capacity of 500,000 t/yr. Overall installed capacity in 1997 was about 105 Mt/yr (World Cement, 1997).

Redland PLC, based in the United Kingdom, was negotiating with the Birla Group to set up a joint venture to produce ready-mix concrete for the Delhi area, which has been undergoing considerable growth. If realized, then both companies would have a 50% equity share (Industrial Minerals, 1997).

India was the world's largest diamond cutting and polishing nation, accounting for more than 80% of the world's diamond by

volume, or about 45% by value. India added value to the smaller imported rough, or uncut and unpolished, stones that otherwise would not be marketed. India imported more than 70% of the world's output of gem-grade rough diamond to meet the requirements of its cutting and polishing industry. As a result, India also was a leading exporter of diamond, and the industry has become the country's second largest earner of foreign exchange. Domestic production remained small (U.S. Consulate, Mumbai, India, 1997, p. 3).

The major source rocks for diamond in the country are primary kimberlite pipes, secondary conglomerates, and recent gravels. The NMDC mined diamond from its 30,000-carat mine in the Panna District, Madhya Pradesh. Diamond also was recovered from conglomerate and gravel beds at shallow depths by small operators granted annual permits by the Government of Madhya Pradesh (Indian Bureau of Mines, 1996, p. 321).

The Bharat Diamond Bourse in Mumbai, the largest and most modern bourse of its kind in the world, became fully operational during the year, accommodating all activities of the diamond trade except manufacturing under one roof. It is planned to make India a trading center for rough diamond equal to those of Tel Aviv and Antwerp (Cockle, 1998).

India depended on imports for a large portion of its domestic phosphate requirements. About 2 Mt/yr of phosphate rock are imported. Low-grade phosphate (11% to 22% P_2O_5) was mined in the States of Madhya Pradesh, Rajasthan, and Uttar Pradesh (Tandon, 1998, p. 13).

Coal accounted for about 60% of India's energy demand. India was the world's fifth largest coal producer and ranked third, following the United States and China, in the production of bituminous coal. Opencast mines, numbering about one-third of India's approximate 530 operating coal mines, produced about 75% of total coal production. The main coalfields are in Bihar, Madhya Pradesh, and West Bengal. India has abundant lignite and bituminous coal reserves, but its metallurgical coal reserves are small. The noncoking coals are high in ash content. Coal India Ltd., owned by the central Government, produces 90% of the country's coal (U.S. Energy Information Administration, July 1998, India—Coal, accessed July 30, 1998, at URL http://www.eia.doe.gov/emeu/cabs/india.html#coal).

Nearly a quarter century after the country's coal industry was nationalized (1973), the Government's coal policy was reversed in February 1997 with the decision to allow Indian corporations to mine lignite and coal and foreign companies to enter the coal mining sector through equity participation. The Government also further deregulated coal prices to make coal production profitable (Mining Journal, 1997b).

Petroleum accounts for about one-third of India's total energy consumption. The majority of the country's oil reserves are located in the Bombay High, the Cambay, the Cauvery, the Krisha-Godavari, and the Upper Assam Basins. The Bombay High oilfields continued to account for the bulk of India's crude oil production. The State-owned Oil and Natural Gas Corp. remained India's largest upstream oil company, producing about 90% of production. Oil India Ltd., also State-owned, accounted for the country's remaining production. India was about 45% self-sufficient in petroleum production (U.S. Embassy, New Delhi, India, 1997, p. 2).

To meet increasing domestic oil demand, India embarked on an ambitious petroleum refinery expansion program with at least 12 projects underway. Bharat Petroleum Corp. Ltd. and Royal Dutch/Shell are constructing a $770 million, 120,000-barrel-per-day (bbl/d) refinery at Sultanpur in Uttar Pradesh. Indian Oil Corp. (IOC) and Kuwait Petroleum Corp. are building a $1.3 billion, 120,000-bbl/d refinery in Orissa. The plant, which could be expanded to 200,000 bbl/d, has been slated for completion in 2000. Other planned projects include a $1.25 billion, 120,000-bbl/d refinery by Bharat Petroleum and Oman Oil Co. in joint venture at Bina, Madhya Pradesh, a $450-million, 96,000-bbl/d plant by Petro Energy in Pondicherry Territory, a 60,000-bbl/d expansion of the 90,000-bbl/d Visakhapatnam refinery by Hindustan Petroleum Corp. Ltd., and two other expansion projects by IOC in West Bengal.

Natural gas supplied about 10% of India's energy demand. Almost 70% of India's natural gas reserves are in the Bombay High and the Gujarat Basins. More than 20% of India's offshore gas production was flared because of a lack of distribution infrastructure. The State-owned Gas Authority of India Ltd. was planning to spend at least $2 billion by 2000 to expand the country's gas production and related infrastructure. This will include a new gas pipeline link between Mumbai and Bangalore as well as extensions to the country's Hazira-Bijapur-Jagdishpur trunk line (U.S. Energy Information Administration, July 1998, India—Oil, accessed July 30, 1998, at URL http://www.eia.doe.gov/emeu/cabs/india.html#oil).

Within the DAE, the Atomic Minerals Division (AMD) was responsible for conducting radiometric and geologic surveys and for the exploration and development of various mineral resources necessary for the country's nuclear power program. The AMD located uranium deposits containing significant concentrations (0.55% uranium oxide) in quartz formations in the northern parts of the Cuddapah Basin of Andhra Pradesh (Mining Journal, 1997b).

Also within the DAE, the Uranium Corp. of India Ltd. (UCIL) operated uranium mines at Jaduguda and Bhatin, a uranium mill at Jaduguda, and uranium recovery plants at Mosaboni, Rakha, and Surda, all in Bihar. UCIL also has the capability of recovering other metals and minerals, such as copper, magnetite, and molybdenite, as byproducts.

Under the auspices of the DAE, the Nuclear Power Corp. of India Ltd. operated 10 nuclear power stations at 5 sites within India—Kakrapar Atomic Power Station Units I and II, each having the capacity to generate 220 MW, at Kakrapar in Gujarat; Madras Atomic Power Station Units I and II, each having the capacity to generate 220 MW, at Kalpakkam near Madras in Tamil Nadu; Narora Atomic Power Station Units I and II, each having the capacity to generate 220 MW, at Narora in Uttar Pradesh; Rajasthan Atomic Power Station Unit I, having the capacity to generate 100 MW, and Unit II, with the capacity to generate 200 MW, at Rawatbhata, near Kota in Rajasthan; and Tarapur Atomic Power Station Units I and II, each having the capacity to generate 160 MW, at Tarapur, Maharashtra. These units accounted for slightly more than 2% of India's total electricity generation (U.S. Energy Information Administration, September 1997, Nuclear power generation and fuel cycle report 1997, accessed June 10, 1998, at URL http://www.eia.doe.gov/cneaf/nuclear/n_pwr_fc/).

Just about all modes of transportation are used for mineral transport in India, including aerial ropeways used in preference to conveyor belts over stretches of uneven terrain at some mining operations. The Indian road network, one of the largest in the world, consisted of 2,009,600 km, including 1,006,810 km that was paved and 1,002,790 km that comprised gravel, crushed stone, or

unimproved earth. Inland waterways, of which 16,180 km were usable by all craft and 3,631 km were navigable by large vessels, are of little importance to the minerals industry. Sea transport, however, is the only method used for importing and exporting minerals to and from the country's ports, of which the major ones include Calcutta, Chennai (Madras), Cochin, Jawaharal Nehru, Kandla, Mumbai, and Vishakapatnam on the mainland, and Port Blair in the Andaman and Nicobar Islands Territory. The merchant marine fleet included 132 bulk ore freighters; 75 petroleum, oils, and lubricant tankers; 8 chemical tankers; 8 liquefied gas tankers; 3 combination ore-oil tankers; and 3 combination bulk ore freighters. The Indian railway system, Asia's largest and the world's fourth largest, consisted of 62,462 km of track, of which 37,824 km was 1.676-m broad gauge; 20,653 km, 1.000-m gauge; and 3,985 km, 0.762- or 0.610-m narrow gauge, as well as 11,793 km of electrified rail. The mixed gauges of track create difficulties, such as loss of time in transshipment and the requirement for multiple stocking of spare parts. In addition, the rail system had a profusion of obsolete equipment that is unreliable and expensive to maintain. Of the 288 airports in the country, 248 were principal and had permanent-surface runways. Pipelines included 3,005 km for crude oil, 2,687 km for refined oil products, and 1,700 km for natural gas (Central Intelligence Agency, 1998, India—Transportation, accessed June 10, 1998, at URL http://www.odci.gov/cia/publications/factbook/in .html).

Electric generating capacity in 1996 was 83.288 gigawatts (GW), of which about 74% was generated by thermal plants, 24% by hydroelectric plants, and 2% by nuclear facilities (Asian Chemical News, 1997). Some of the major industrial on-site capacity was dedicated to specific plants, particularly in the aluminum and copper sectors. India was planning to have an installed capacity of 10 GW of nuclear-generated power by 2000. Total production of electrical power in 1995 was 380 billion kilowatt-hours (Central Intelligence Agency, 1998, India—Economy, accessed June 10, 1998, at URL http://www.odci.gov/cia/publications/factbook/in.html).

References Cited

Asian Chemical News, 1997, More power used: Asian Chemical News, v. 3, no. 142, October 6, p. 24.

Cockle, M., 1998, Diamond centers—Bombay *in* World Diamond Industry Directory and Yearbook 1997/98: London, CRU Publishing Ltd., p. 32.

India Weekly Fax Bulletin, 1998, FDI rules relaxed: India Weekly Fax Bulletin, February 9, p. 1.

Indian Bureau of Mines, 1996, Indian minerals yearbook 1995: Indian Bureau of Mines, p. 321.

Industrial Minerals, 1997, Redland and Birla in ready mixed concrete j-v: Industrial Minerals, no. 360, p. 24-27.

Metal Bulletin, 1997a, Hindalco signs deal for Orissa smelter: Metal Bulletin, no. 8168, April 7, p. 6.

———1997b, Indian Lead to build new refinery in Wada: Metal Bulletin, no. 8155, February 20, p. 12.

———1997c, India looks for outside adviser for BALCO sale: Metal Bulletin, no. 8239, December 22, p. 7.

———1997d, India's Binani invests to expand capacity: Metal Bulletin, no. 8167, April 3, p. 3.

———1997e, India set to sell 30% of Kudremukh: Metal Bulletin, no. 8233, December 1, p. 23.

———1997f, NALCO expands alumina refinery: Metal Bulletin, no. 8213, September 22, p. 6.

———1997g, Sterlite resumes output at reduced levels: Metals Bulletin, no. 8229, November 17, p. 11.

———1998, Hindalco reaps the benefit of modernization with improved results: Metal Bulletin, no. 8277, May 14, p. 6.

Metal Bulletin Monthly, 1997a, India's copper revolution: Metal Bulletin Monthly, no. 320, p. 19.

———1997b, India's Mn alloy industry faces an uncertain future: Supplement to Metal Bulletin Monthly, no. 323, p. 47.

Mining Journal, 1997a, HZL mine closure: Mining Journal, v. 328, no. 8433, June 13, p. 467.

———1997b, India moves on: Supplement to Mining Journal, v. 329, no. 8446, September 12, p. 79-81.

Mining Magazine, 1997, India opens up: Mining Magazine, v. 176, no. 2, p. 100.

Platt's Metals Week, Birla refinery to start Feb. 24: Platt's Metals Week, v. 69, no. 6, February 9, p. 13.

Seshadri, G.R., 1998, India: Mining Journal, v. 331, no. 8489, July 17, p. 36-39.

Tandon, B.B., 1998, New investment opportunities in India in the mining sector: Global Mining Investment Opportunities Symposium, May 4-6, 1998, Montreal, Canada, 20 p.

U.S. Consulate, Mumbai, India, 1997, The Indian diamond industry—Adapting to a changing environment: U.S. State Department Telegram 0934, February 19, 5 p.

U.S. Embassy, New Delhi, India, 1997, 1997 investment climate statement for India: U.S. State Department Telegram 006402, June 23, 21 p.

World Cement, 1997, Growth anomalies in the Indian cement industry: World Cement, v. 28, no. 8, p. 44.

Major Sources of Information

Foreign Investment Promotion Board
Udyog Bhawan
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Major Publications

Ministry of Steel and Mines, Indian Bureau of Mines, Nagpur: Monthly Statistics of Mineral Production, Indian Minerals Yearbook.

Ministry of Planning, Department of Statistics, Central Statistical Organization, New Delhi: Monthly Abstract of Statistics.

Mining Engineers' Association of India, Mumbai: The Indian Mining and Engineering Journal, monthly.

Balkrishna Binani, Mumbai: Minerals and Metals Review, monthly.

TABLE 1
INDIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	5,227	4,809	5,240 r/	5,257 r/	5,800
Alumina, Al_2O_3 equivalent	do.	1,490	1,456	1,650	1,700 e/	1,700
Metal, primary		466,423	472,000	536,500 r/	530,600 r/	484,200 3/
Cadmium metal		255	216	254	271 r/	298 3/
Chromium, chromite, gross weight		1,000,073	909,076	1,536,386	1,363,205	1,363,049 3/
Copper:						
Mine output, Cu content		49,416	45,944	46,975	47,800 r/	40,000
Metal, primary:						
Smelter		37,372	51,232	39,496	45,300 r/	45,000
Refinery						
Electrolytic (cathode)		30,100	40,100	33,900	29,100	30,200
Fire refined		6,700	8,900	5,700 r/ e/	10,200 r/ e/	6,000
Total		36,800	49,000	39,600 r/	39,300 r/	36,200 3/
Gold metal, smelter	kilograms	2,003	2,244	2,203 r/	2,449 r/	2,500
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	57,375	60,473	65,173 r/	66,657 r/	67,000
Fe content	do.	36,720	37,368	41,710 r/	42,600 r/	42,900
Metal:						
Pig iron	do.	15,674	17,808	18,026 r/	19,864 r/	20,000
Direct-reduced iron	do.	2,208	3,122	4,280	4,830 r/	5,250 3/
Ferroalloys:						
Ferrochromium (including charge chrome)		228,000 r/	247,000 r/	303,537 r/	261,666	286,973 3/
Ferrochromiumsilicon e/		8,000	8,000	9,000	9,000	10,000
Ferromanganese e/		137,291 3/	200,000 r/	180,000 r/	190,000 r/	190,000
Ferrosilicon e/		67,600 3/	85,000	85,000	85,000	90,000
Silicomanganese e/		85,000 3/	170,000 r/	190,000 r/	170,000 r/	170,000
Other e/		8,600	8,500	8,500	8,500	9,000
Steel, crude	thousand tons	18,155	19,285	22,800 r/	23,753 r/	23,748 3/
Semimanufactures e/ 4/	do.	9,000	11,000	11,000	11,000	11,000
Lead:						
Mine output, Pb content		26,000	30,500	34,000 r/	35,000 r/	32,000 3/
Metal, refined:						
Primary e/		66,000 r/	60,000 r/	62,000 r/	67,000 r/	69,000
Secondary e/		12,200 r/	21,700	28,000	27,000	24,000
Total		78,200 r/	81,700 r/	90,000 r/	94,000 r/	93,000
Manganese:						
Ore and concentrate, gross weight	thousand tons	1,655	1,632	1,764	1,797 r/	1,800
Mn content e/	do.	628	620	670	680 r/	680
Rare-earth metals, monazite concentrate, gross weight e/		4,600	4,600	5,000	5,000	5,000
Selenium	kilograms	11,116	11,582	11,449	11,500 e/	11,500
Silver, mine and smelter output	do.	51,228	50,207	38,064	35,600 r/	35,000
Titanium concentrates, gross weight:						
Ilmenite e/		320,000	300,000	300,000	300,000	300,000
Rutile e/		13,900	14,000	14,000	14,000	15,500
Tungsten, mine output, W content		1	2	4 r/	2	3
Zinc:						
Mine output, concentrate:						
Gross weight		300,736	270,382	279,757 r/	286,226 r/	273,222 3/
Zn content		156,300	147,300	154,500	148,200	142,000 3/
Metal:						
Primary		141,700	156,400	146,500	143,600	159,000 3/
Secondary e/		24,000 r/	24,000 r/	24,000 r/	24,000 r/	24,000
Total e/		165,700 r/	180,400 r/	170,500 r/	167,600 r/	183,000
Zirconium concentrate, zircon, gross weight e/		17,000	18,000	18,000	19,000 r/	19,000
INDUSTRIAL MINERALS						
Abrasives, natural, n.e.s.:						
Corundum, natural		15	14	14	14 r/	14
Garnet		47,785	56,196	58,937 r/	47,382 r/	50,000

See footnotes at end of table.

TABLE 1--Continued
INDIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
INDUSTRIAL MINERALS--Continued						
Abrasives, natural, n.e.s.--Continued:						
Jasper		5,627	4,577	5,342 r/	4,740 r/	5,000
Asbestos		44,080	29,824	25,065 r/	23,215 r/	25,000
Barite		547,875	497,971	420,704	369,500 r/	400,000
Bromine, elemental e/		1,400	1,400	1,500	1,500	1,500
Cement, hydraulic e/	thousand tons	53,812 3/	57,000 r/	62,000 r/	75,000 r/	80,000
Chalk		98,966	139,300	144,124 r/	122,318 r/	140,000
Clays:						
Ball clay		336,880	347,741	413,722 r/	396,472 r/	400,000
Diaspore		12,197	9,463	10,086	14,192 r/	14,000
Fireclay		439,950	397,435	406,901 r/	346,599 r/	350,000
Kaolin:						
Salable crude	thousand tons	519	548	552	578 r/	575
Processed	do.	129	134	161 r/	183 r/	190
Total	do.	648	682	713 r/	761 r/	765
Other	do.	40	50	73	55 r/	60
Diamond:						
Gem e/	thousand carats	13	15	14	19 r/	20
Industrial e/	do.	7	3	8	10 r/	10
Total	do.	20	18	22	29 r/	30
Feldspar		66,792	64,693	99,618 r/	85,213 r/	90,000
Fluorspar:						
Concentrates:						
Acid-grade		7,798	6,231	6,359 r/	5,115 r/	5,100
Metallurgical-grade		13,846	16,360	17,887 r/	14,263 r/	14,000
Total		21,644	22,591	24,246 r/	19,378 r/	19,100
Other fluorspar materials, graded		4,782	3,415	5,762 r/	3,292 r/	3,300
Gemstones excluding diamond:						
Agate including chalcedony pebble		680	639	518	467 r/	500
Garnet	kilograms	1,058	533	484 r/	627 r/	600
Graphite 5/		82,398	93,597	129,368 r/	115,233 r/	120,000
Gypsum		1,804,661	1,729,775	1,744,331 r/	2,442,156 r/	2,500,000
Kyanite and related materials:						
Kyanite		11,600	6,265	6,772 r/	6,715 r/	6,700
Sillimanite		15,563	10,378	9,687 r/	7,521 r/	7,500
Lime		200,000 r/ e/	200,000 r/ e/	94,734 r/	202,437 r/	200,000
Magnesite		408,971	336,735	335,189 r/	373,306 r/	375,000
Mica:						
Crude		2,082	2,055	1,728 r/	1,894 r/	2,000
Scrap and waste		1,187	719	1,013 r/	1,413 r/	1,400
Total		3,269	2,774	2,741 r/	3,307 r/	3,400
Nitrogen, N content of ammonia	thousand tons	7,176	7,503 r/	8,287 r/	8,549 r/	9,298 3/
Phosphate rock including apatite		969,385	1,236,567 r/	1,331,829 r/	1,432,321 r/	1,500,000
Pigments, mineral, natural, ocher		138,210	170,761	254,166 r/	284,546 r/	285,000
Pyrites, gross weight		116,930	117,033	135,547 r/	145,922 r/	150,000
Salt:						
Rock salt	thousand tons	3	3	2 r/	2 r/	2
Other e/	do.	9,500	9,500	9,500	9,500	9,500
Total e/	do.	9,503	9,503	9,502 r/	9,502 r/	9,502
Sodium carbonate e/		1,500,000	1,500,000	1,500,000	1,500,000	1,500,000
Stone, sand and gravel:						
Calcite		69,804	67,631	71,073 r/	64,866 r/	65,000
Dolomite	thousand tons	3,498	3,123	3,570	3,132 r/	3,500
Limestone	do.	82,095	8,576	91,612 r/	100,328 r/	100,000
Quartz and quartzite	do.	248	222	257	257 r/	260
Sand:						
Calcareous	do.	272	183	228	225 e/	225
Silica	do.	1,148	1,252	1,222 r/	1,534 r/	1,500
Other	do.	1,540	1,700	1,654	1,379 r/	1,500
Slate		12,134	7,004	6,744 r/	9,451 r/	9,000

See footnotes at end of table.

TABLE 1--Continued
INDIA: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1993	1994	1995	1996	1997 e/
INDUSTRIAL MINERALS--Continued						
Sulfur, byproduct from fertilizer plants		16,920 r/	14,844 r/	22,308 r/	9,316 r/	1,600
Talc and related materials:						
Pyrophyllite		82,269	85,335	131,137	143,172 r/	140,000
Steatite (soapstone)		385,121	398,006	469,692 r/	472,001 r/	470,000
Vermiculite		1,485	1,903	1,696 r/	2,405 r/	2,400
Wollastonite		80,748	68,269	90,128	76,204 r/	80,000
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous	thousand tons	246,041	254,050	267,959 r/	287,935 r/	290,000
Lignite	do.	17,086	19,197	22,052 r/	22,282 r/	22,000
Total	do.	263,127	273,247	290,011 r/	310,217 r/	312,000
Gas, natural:						
Gross	million cubic meters	16,283	16,800 r/	17,800 r/	19,700 r/	19,000
Marketable	do.	12,200 r/ e/	14,685 r/	16,610 r/	18,489 r/	18,500
Petroleum:						
Crude	thousand 42-gallon barrels	201,461	234,536	263,013	270,100 r/	277,400 3/
Refinery products:						
Liquefied petroleum gas	do.	31,800	32,040	38,325 r/	39,000 r/ e/	40,000
Gasoline	do.	30,300	34,560	37,960 r/	38,000 r/ e/	39,000
Kerosene and jet fuel	do.	55,100	55,080	57,670 r/	58,000 r/ e/	59,000
Distillate fuel oil	do.	136,150	144,720	164,250 r/	165,000 r/ e/	166,000
Residual fuel oil	do.	74,800	71,280	69,715 r/	70,000 r/ e/	71,000
Other	do.	88,300	92,880	87,965 r/	88,000 r/ e/	89,000
Total	do.	416,450	430,560	455,885 r/	458,000 r/ e/	464,000

e/ Estimated. r/ Revised.

1/ Table includes data available through July 1, 1998.

2/ In addition to commodities listed, other clays (bentonite, common clays, and fuller's earth), other gemstones (aquamarine, emeralds, ruby, and spinel), and uranium are produced, but output is not reported; available information is inadequate to make reliable estimates of output levels.

3/ Reported figure.

4/ Excludes production from steel miniplants.

5/ India's marketable production is 10% to 20% of mine production.

TABLE 2
INDIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity e/
Alumina	Indian Aluminium Co. Ltd. Indian interests, 60.4% and Alcan Aluminium Ltd. (Canada), 39.6%	Belgaum Refinery, Karnataka	220
Do.	National Aluminium Co. Ltd., Indian Government, 100%	Dhamanjodi Refinery, Orissa	800
Do.	Bharat Aluminium Co. Ltd., Indian Government, 100%	Korba Refinery, Madhya Pradesh	200
Do.	Utkal Alumina International. Alcan Aluminium Co. Ltd. (Canada), Indian Aluminium Co. Ltd., Norsk Hydro SA (Norway), Tata Industries, and Tata Iron and Steel Co. Ltd., 20% each	Koraput Refinery, Orissa	1,000 1/
Do.	Madras Aluminium Co. Ltd. Alumix SpA (Italian Government), 27%; R. Prabhu and Associates, 24%; Tamil Nadu Industrial Investment Corp., 11%, and others, 38%	Mettur Refinery, Tamil Nadu	60
Do.	Indian Aluminium Co. Ltd. Indian interests, 60.4% and Alcan Aluminium Ltd. (Canada), 39.6%	Muri Refinery, Bihar	72
Do.	Hindalco Industries Ltd. Birla Group, 33%; foreign investors, 26%; private Indian investors, 23%; and financial institutions, 18%	Renukoot Refinery, Uttar Pradesh	450
Aluminum	Indian Aluminium Co. Ltd. Indian interests, 60.4% and Alcan Aluminium Ltd. (Canada), 39.6%	Alupuram Smelter, Kerala	20
Do.	National Aluminium Co. Ltd., Indian Government, 100%	Angul Smelter, Orissa	230
Do.	Indian Aluminium Co. Ltd. Indian interests, 60.4% and Alcan Aluminium Ltd. (Canada), 39.6%	Belgaum Smelter, Karnataka	73
Do.	do.	Hirakud Smelter, Orissa	24
Do.	Bharat Aluminium Co. Ltd., Indian Government, 100%	Korba Smelter, Madhya Pradesh	100
Do.	Madras Aluminium Co. Ltd. Alumix SpA (Italian Government), 27%; R. Prabhu and Associates, 24%; Tamil Nadu Industrial Investment Corp., 11%; and others, 38%	Mettur Smelter, Tamil Nadu	25
Do.	Hindalco Industries Ltd. Birla Group, 33%; foreign investors, 26%; private Indian investors, 23%; and financial institutions, 18%	Renukoot Smelter, Uttar Pradesh	242
Bauxite	Bharat Aluminium Co. Ltd., Indian Government, 100%	Amarkantak Mine, Madhya Pradesh	200
Do.	Indian Aluminium Co. Ltd. Indian interests, 60.4% and Alcan Aluminium Ltd. (Canada), 39.6%	Kolhapur District mines, Maharashtra	600
Do.	Gujarat Mineral Development Corp., Gujarat State Government, 100%	Kutch and Saurashtra Mines, Gujarat	500
Do.	Hindalco Industries Ltd. Birla Group, 33%; foreign investors, 26%; private Indian investors, 23%; and financial institutions, 18%	Lohardaga District mines, Bihar	750
Do.	Indian Aluminium Co. Ltd. Indian interests, 60.4% and Alcan Aluminium Ltd. (Canada), 39.6%	do.	200
Do.	National Aluminium Co. Ltd., Indian Government, 100%	Panchpatmali Hills, Koraput District mines, Orissa	2,400
Do.	Minerals & Minerals Ltd., Indian Government, 100%	Richuguta, Palamu District mines, Bihar	200
Barite	Andhra Pradesh Mineral Development Corp. Ltd. Andhra Pradesh State Government, 100%	Cuddapah District mines, Andhra Pradesh	350
Do.	Associated Mineral Corp., 100%	do.	75
Do.	Pragathi Minerals, 100%	do.	50
Do.	Shri C. M. Ram nath Reddy, 100%	do.	75
Do.	Vijaylaxmi Minerals Trading Co., 100%	do.	50
Cement	Larsen and Toubro Ltd., 100%	Awarpur Plant, Maharashtra	2,300
Do.	Century Cement. Century Textiles and Industries Ltd., a subsidiary of the Birla Group, 100%	Baikunth Plant, Madhya Pradesh	1,120
Do.	Coromandel Fertilizers Ltd. Chevron Chemical Co. (United States), 23.55%; International Minerals and Chemical Co., 20.89%; Parry and Co., 10.64%; E.I.D. Parry (India) Ltd., 6.65%; and others, 38.27%	Chilamkur Plant, Andhra Pradesh	1,000
Do.	The Associated Cement Cos. Ltd. Indian Government, 34.86% and private shareholders, 65.14%	Gagal Plant, Himachal Pradesh	1,830
Do.	Raymond Cement Works, a division of Raymond Woolen Mills Ltd. JK Singhania, principal shareholder	Gopalnagar Plant, Madhya Pradesh	1,250
Do.	Narmada Cement Co. Ltd. Chowgule and Co. Ltd., 34%; Gujarat State Government, 17.33%; and others, 48.67%	Jafrabad Plant, Gujarat	1,000
Do.	Rajashree Cement, a division of Indian Rayon and Industries Ltd., 100%	Khor Plant, Karnataka	1,020

See footnotes at end of table.

TABLE 2--Continued
INDIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity e/
Cement--Continued:				
Do.		The Associated Cement Cos. Ltd. Indian Government, 34.86% and private shareholders, 65.14%	Kymore Plant, Madhya Pradesh	1,500
Do.		Mangalam Cement Ltd., 100%	Morak Plant, Rajasthan	1,000
Do.		Mysore Cements Ltd. Government institutions and banks, 41.13%; Corporate Trust holdings, 21.70%; and others, 37.17%	Narasingarh Plant, Madhya Pradesh	1,089
Do.		Cement Corp. of India Ltd., Indian Government, 100%	Nayagaon Plant, Madhya Pradesh	1,330
Do.		J.K. Cement Works, a division of JK Synthetics Ltd., 100%	Nimbahera Plant, Rajasthan	1,462
Do.		The India Cement Co. Ltd., Indian Government, 26%; Life Insurance Corp. of India, 24%; and others, 50%	Sankarnagar Plant, Tamil Nadu	1,000
Do.		Maihar Cement. Century Textiles and Industries Ltd., a subsidiary of the Birla Group, 100%	Satna Plant, Madhya Pradesh	1,800
Do.		Shree Digvijay Cement Co. Ltd., 100%	Shreeniwas Plant, Maharashtra	1,060
Do.		Lakshmi Cement, a division of Straw Products Ltd. JK Singhania, principal shareholder	Sirohi Plant, Rajasthan	1,400
Do.		Manikgarth Cement. Century Textiles and Industries Ltd., a subsidiary of the Birla Group, 100%	Tehsil Rajura Plant, Maharashtra	1,000
Do.		Vasavadatta Cement. Kesoram Industries Ltd., 100%	Vasavadatta Plant, Karnataka	1,000
Do.		Vikram Cement. Grasim Industries Ltd., a subsidiary of the Birla Group, 100%	Vikram Plant, Madhya Pradesh	1,000
Do.		Raasi Cement Ltd., Andhra Pradesh Government, 50% and Development Co. Ltd., 50%	Vishnupuram Plant, Andhra Pradesh	1,000
Do.		The Associated Cement Cos. Ltd., Indian Government, 34.86% and private shareholders, 65.14%	Wadi Plant, Karnataka	2,180
Chromite		Ferro Alloys Corp. Ltd., 100%	Cuttack District, Orissa	120
Do.		Orissa Mining Corp. Ltd. Orissa Industries Ltd., 100%	do.	300
Do.		Tata Iron & Steel Co. Ltd., 100%	do.	100
Do.		Ferro Alloys Corp. Ltd., 100%	Dhenkanal District, Orissa	75
Do.		Orissa Mining Corp. Ltd. Orissa Industries Ltd., 100%	do.	200
Do.		Mysore Minerals Ltd., 100%	Hassan District, Karnataka	125
Do.		Ferro Alloys Corp. Ltd., 100%	Kendujhar District, Orissa	75
Do.		Orissa Mining Corp. Ltd. Orissa Industries Ltd., 100%	do.	100
Do.		Ferro Alloys Corp. Ltd., 100%	Khammam District, Andhra Pradesh	100
Coal, bituminous	million tons	Bharat Coking Coal Ltd., a subsidiary of Coal India Ltd., Indian Government, 100%	Bihar and West Bengal	26
Do.	do.	Central Coalfields Ltd., a subsidiary of Coal India Ltd., Indian Government, 100%	Bihar	27
Do.	do.	Eastern Coalfields Ltd., a subsidiary of Coal India Ltd., Indian Government, 100%	Bihar and West Bengal	21
Do.	do.	Mahanadi Coalfields Ltd., a subsidiary of Coal India Ltd., Indian Government, 100%	Orissa	21
Do.	do.	North Eastern Coalfields Ltd., a subsidiary of Coal India Ltd., Indian Government, 100%	Assam	640
Do.	do.	Northern Coalfields Ltd., a subsidiary of Coal India Ltd., Indian Government, 100%	Madhya Pradesh and Uttar Pradesh	24
Do.	do.	Singareni Collieries Co. Ltd., Andhra Pradesh State Government, 50% and Indian Government, 50%	Andhra Pradesh	18
Do.	do.	South Eastern Coalfields Ltd., a subsidiary of Coal India Ltd., Indian Government, 100%	Madhya Pradesh	36
Do.	do.	Western Coalfields Ltd., a subsidiary of Coal India Ltd., Indian Government, 100%	Madhya Pradesh and Maharashtra	18
Coal, lignite	do.	Neyveli Lignite Corp. Ltd., Indian Government, 100%	Tamil Nadu	17
Copper		Indo-Gulf Fertilizers and Chemicals Corp., 100%	Birla Copper Complex smelter, Dahej, Gujarat	100
Do.		Hindustan Copper Ltd., Indian Government, 100%	Indian Copper Complex mines, Ghatsila District, Bihar	31
Do.		do.	Indian Copper Complex smelter-refinery, Ghatsila District, Bihar	16
Do.		do.	Khetri Copper Complex mines, Khetrinagar Rajasthan	15

See footnotes at end of table.

TABLE 2--Continued
INDIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity e/
Copper--Continued:			
Do.	Hindustan Copper Ltd., Indian Government, 100%	Indian Copper Complex mines, Ghatsila District, Bihar	31
Do.	do.	Khetri Copper Complex smelter-refinery, Khetrinagar District, Rajasthan	45
Do.	do.	Malanjkhand Copper Complex mines, Balaghar District, Madhya Pradesh	22
Do.	Sterlite Industries Ltd., 100%	Tuticorin Smelter, Tamil Nadu	100
Ilmenite-rutile ore	Kerala Minerals and Metals Ltd., Kerala State Government, 100%	Chavara, Kerala	100
Do.	Indian Rare Earths Ltd., Indian Government, 100%	do.	200
Do.	do.	Ganjam, Orissa	220
Do.	do.	Manavalakurichi, Tamil Nadu	65
Iron and steel:			
Crude steel	Visvesvaraya Iron and Steel Ltd., Karnataka State, 60% and Steel Authority of India Ltd., Indian Government, 40%	Bhadravati steel plant, Karnataka	180
Do.	Steel Authority of India Ltd., Indian Government, 100%	Bhilai steel plant, Madhya Pradesh	4,000
Do.	do.	Bokaro steel plant, Bihar	4,000
Do.	Indian Iron and Steel Co. Ltd., wholly owned subsidiary of Steel Authority of India Ltd., Indian Government, 100%	Burnpur steel plant, West Bengal	1,500
Do.	Steel Authority of India Ltd., Indian Government, 100%	Durgapur steel plant, West Bengal	1,600
Do.	Tata Iron and Steel Co. Ltd., 100%	Jamshedpur steel plant, Bihar	3,200
Do.	Steel Authority of India Ltd., Indian Government, 100%	Rourkela steel plant, Orissa	1,800
Do.	Rashtriya Ispat Nigam Ltd., 100%	Visakhapatnam steel plant, Andhra Pradesh	3,200
Do.	Ministeel plants, privately owned	About 180 plants located throughout India	4,700
Iron ore	National Mineral Development Corp. Ltd., Indian Government, 100%	Bailadila, Madhya Pradesh	9,000
Do.	Steel Authority of India Ltd., Indian Government, 100%	Bastar and Durg District, Madhya Pradesh	7,000
Do.	Kudremukh Iron Ore Co. Ltd., Indian Government, 100%	Kudremukh, Chikmagalur District, Karnataka	9,500
Do.	National Mineral Development Corp. Ltd., Indian Government, 100%	Donimalai, Karnataka	9,000
Do.	Chowgule & Co. Pvt. Ltd., 100%	Goa	2,500
Do.	Dempo Mining Corp. Ltd., 100%	Goa	2,500
Do.	V.M. Salgaocar & Bros. Pvt. Ltd., 100%	Goa	2,500
Do.	Steel Authority of India Ltd., Indian Government, 100%	Kendujhar District, Orissa	3,000
Do.	Tata Iron and Steel Co. Ltd., 100%	do.	2,000
Do.	Indian Iron and Steel Co. Ltd., wholly owned subsidiary of Steel Authority of India Ltd., Indian Government, 100%	Singhbhum District, Bihar	2,500
Do.	Steel Authority of India Ltd., Indian Government, 100%	do.	3,500
Do.	Tata Iron and Steel Co. Ltd., 100%	do.	3,500
Kyanite	Associated Mining Co., 100%	Bhandara District, Maharashtra	10
Do.	Maharashtra Mineral Corp. Ltd., 100%	do.	10
Do.	Bihar State Mineral Development Corp. Ltd., Bihar State Government, 100%	Singhbhum District, Bihar	10
Do.	Hindustan Copper Ltd., Indian Government, 100%	do.	22
Lead ore	Hindustan Zinc Ltd., Indian Government, 100%	Agnigundala Mine, Andhra Pradesh	72
Do.	do.	Sargipalli Mine, Orissa	150
Lead, primary	do.	Chanderiya Smelter, Rajasthan	35
Do.	do.	Tundoo Smelter, Bihar	8
Do.	do.	Visakhapatnam (Vizag) Smelter, Andhra Pradesh	22
Lead, secondary	Indian Lead Co., 100%	Thane Refinery, Mumbai, Maharashtra	25
Lead-zinc ore	do.	Rampura-Agucha Mine, Rajasthan	1,300
Do.	do.	Zawar mine group, Rajasthan	1,200
Magnesite	Burn Standard Co. Ltd., Indian Government, 100%	Salem, Tamil Nadu	150
Do.	Dalmia Magnesite Corp., 100%	do.	150
Do.	Tamil Nadu Magnesite Ltd., Tamil Nadu State Government, 100%	do.	150
Manganese ore 2/	Manganese Ore India Ltd., Indian Government, 100%	Adilabad, Andhra Pradesh	NA
Do.	Falechand Marsingdas, 100%	Andhra Pradesh	NA
Do.	Manganese Ore India Ltd., Indian Government, 100%	Balaghat, Madhya Pradesh	NA

See footnotes at end of table.

TABLE 2--Continued
INDIA: STRUCTURE OF THE MINERAL INDUSTRY IN 1997

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity e/
Manganese ore 2/--Continued:			
Do.	J.A. Trivedi Bros., 100%	Balaghat, Madhya Pradesh	NA
Do.	Sandur Manganese and Iron Ores Ltd., 100%	Bellary, Karnataka	NA
Do.	Manganese Ore India Ltd., Indian Government, 100%	Bhandara, Maharashtra	NA
Do.	Eastern Mining Co., 100%	North Kanara, Karnataka	NA
Do.	Mysore Minerals Ltd., 100%	do.	NA
Do.	Manganese Ore India Ltd., Indian Government, 100%	Keonjhar, Orissa	NA
Do.	Mangilah, Rungta (Pvt.) Ltd., 100%	do.	NA
Do.	Orissa Mining Corp. Ltd., 100%	do.	NA
Do.	Rungta Mines (Pvt.) Ltd., 100%	do.	NA
Do.	Serajuddin & Co., 100%	do.	NA
Do.	S. Lall & Co., 100%	do.	NA
Do.	Tata Iron and Steel Co. Ltd., 100%	do.	NA
Do.	Orissa Mineral Development Co. Ltd., 100%	Koraput, Orissa	NA
Do.	Orissa Mining Corp. Ltd., 100%	do.	NA
Do.	Mysore Minerals Ltd., 100%	Shimoga, Karnataka	NA
Do.	Aryan Mining & Trading Corp., 100%	Sundargarh, Orissa	NA
Do.	Orissa Manganese & Minerals (Pvt.) Ltd., 100%	Sundargarh, Orissa	NA
Do.	Tata Iron and Steel Co. Ltd., 100%	do.	NA
Do.	R.B.S. Shreeram Durga Prasad and Falechand Marsingdas, 100%	Vizianagaram, Andhra Pradesh	NA
Petroleum, refined products thousand 42-gallon barrels per day	Cochin Refineries Ltd., a subsidiary of Oil and Natural Gas Corp., Indian Government, 55% and private interests, 45%	Ambalamugal Refinery, Kerala	93,000
Do.	Indian Oil Corp., a subsidiary of Oil and Natural Gas Corp., Indian Government, 91% and private interests, 9%	Barauni Refinery, Bihar	66,000
Do.	Bongaigaon Refinery and Petrochemicals Ltd., a subsidiary of Oil and Natural Gas Corp., Indian Government, 100%	Bongaigaon Refinery, Assam	27,000
Do.	Indian Oil Corp., a subsidiary of Oil and Natural Gas Corp., Indian Government, 91% and private interests, 9%	Digboi Refinery, Assam	12,000
Do.	do.	Guwahati Refinery, Assam	20,000
Do.	do.	Haldai Refinery, West Bengal	61,000
Do.	do.	Koyali Refinery, Gujarat	185,000
Do.	Madras Refineries Ltd., a subsidiary of Oil and Natural Gas Corp., Indian Government, 52% and private interests, 48%	Madras Refinery, Tamil Nadu	131,000
Do.	Bharat Petroleum Corp. Ltd., a subsidiary of Oil and Natural Gas Corp., Indian Government, 67%, and private interests, 33%	Mahul Refinery, Mumbai (Bombay), Maharashtra	135,000
Do.	Industan Petroleum Corp. Ltd., a subsidiary of Oil and Natural Gas Corp., Indian Government, 51% and private interests, 49%	do.	110,000
Do.	do.	Visakhapatnam Refinery, Andhra Pradesh	90,000
Do.	Indian Oil Corp., a subsidiary of Oil and Natural Gas Corp., Indian Government, 91% and private interests, 9%	Mathura Refinery, Uttar Pradesh	156,000
Phosphate rock 3/	Rajasthan State Mineral Development Corp. Ltd., Rajasthan State Government, 100%	Badgaon, Dakankotra, Kanpur, Kharbaria-ka-Guda, and Sallopat Mines, Rajasthan	NA
Do.	Pyrites Phosphates and Chemicals Ltd., 100%	Durmala and Maldeota underground mines, Uttar Pradesh	NA
Do.	Madhya Pradesh State Mining Corp. Ltd., Pradesh State Government, 100%	Hirapur and Khatamba Mines, Madhya Pradesh	NA
Do.	Rajasthan State Mines and Minerals Ltd., Rajasthan State Government, 100%	Jhamarkotra Mine, Rajasthan	NA
Do.	Hindustan Zinc Ltd., Indian Government, 100%	Maton Mine, Rajasthan	NA
Zinc	Binani Zinc Ltd., 100%	Binanipuram Smelter, Kerala	30
Do.	Hindustan Zinc Ltd., Indian Government, 100%	Chanderiya Smelter, Rajasthan	70
Do.	do.	Debari Smelter, Rajasthan	49
Do.	do.	Visakhapatnam (Vizag) Smelter, Andhra Pradesh	30

e/ Estimated. NA Not available.
1/ Scheduled for startup in 1998.
2/ Capacity of clusters of surface mines varies extremely, depending on demand. Estimated total capacity is 1.5 million metric tons per year.
3/ Estimated total annual phosphate rock capacity is 800,000 metric tons.

TABLE 3
INDIA: RECOVERABLE RESERVES OF MINERAL COMMODITIES IN 1997

(Thousand metric tons unless otherwise specified)

Commodity		Proved	Probable	Possible	Total
Metals:					
Bauxite		668,041	550,470	1,306,828	2,525,339
Copper:					
Ore		173,751	154,637	102,657	431,046
Metal		1,801	1,644	1,112	4,557
Gold:					
Ore	metric tons	5,188,328	6,612,504	5,894,900	17,695,732
Metal	do.	21	26	19	67
Iron ore (hematite)		4,689,298	2,824,316	2,088,306	9,601,920
Iron ore (magnetite)		1,766,290	781,835	594,611	3,142,736
Lead and zinc:					
Ore		71,053	38,341	80,157	189,550
Lead metal		915	548	963	2,426
Zinc metal		4,666	2,166	3,167	10,000
Molybdenum:					
Ore		--	36,000	8,000,900	8,036,900
MoS_2		--	62	2,764	2,826
Tin:					
Ore		56,235	--	28,851,000	28,907,235
Metal		226	--	3,046	3,272
Titanium		33,916	46,378	22,127	102,421
Tungsten:					
Ore		6,682,000	9,265,690	23,704,167	39,651,856
WO_3		9,442	7,693	72,954	90,089
Vanadium:					
Ore		2,870,875	5,292,000	5,173,920	13,336,795
Metal		6,172	7,020	7,195	20,387
Silver:					
Ore		48,771,805	56,763,273	33,628,294	139,163,372
Metal		1,562	941	1,046	3,549
Industrial minerals:					
Asbestos		--	--	--	9,383
Barite		--	--	--	87,062
Bentonitic		--	--	--	365,489
China clay		--	--	--	985,969
Diamond	carats	--	--	--	981,515
Dolomite		--	--	--	4,967,467
Feldspar		--	--	--	16,138
Fireclay		--	--	--	696,716
Fluorite		--	--	--	2,952
Graphite		--	--	--	4,579
Kyanite		--	--	--	2,818
Limestone		--	--	--	76,446,006
Magnesite		--	--	--	245,142
Mica		--	--	--	109
Rock phosphate		--	--	--	145,371
Quartz and silica sand		--	--	--	983,527
Sillimanite		--	--	--	50,695
Talc/steatite/soapstone		--	--	--	83,665
Wollastonite		--	--	--	6,294

Source: Indian Bureau of Mines, Nagpur