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MINERAL INDUSTRIES OF

ASIA AND THE PACIFIC

U.S.
DEPARTMENT
OF THE
INTERIOR

BUREAU
OF
MINES

1993

UNITED STATES DEPARTMENT OF THE INTERIOR • Bruce Babbitt, Secretary

BUREAU OF MINES

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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Preface

This edition of the Minerals Yearbook records the performance of the worldwide minerals industry during 1993 and provides background information to assist in interpreting that performance. Content of the individual Yearbook volumes follows:

Volume I, Metals and Minerals, contains annual reports on virtually all metallic and industrial mineral commodities important to the U.S. economy. In addition, a chapter on survey methods used in data collection with a statistical summary of nonfuel minerals and a chapter on trends in mining and quarrying in the metals and industrial mineral industries are included.

Volume II, Area Reports: Domestic, contains chapters on the minerals industry of each of the 50 States, Puerto Rico, Northern Marianas, Island Possessions, and Trust Territory. This volume also has a chapter on survey methods used in data collection, including a statistical summary of domestic nonfuel minerals.

Volume III, Area Reports: International, contains the latest available mineral data on more than 175 foreign countries and discusses the importance of minerals to the economies of these nations. The reports also incorporate location maps, industry structure tables, and an outlook section.

The annual international review is presented as five area reports and one world overview: Mineral Industries of Africa, Mineral Industries of Asia and the Pacific, Mineral Industries of Latin America and Canada, Mineral Industries of Europe and Central Eurasia, Mineral Industries of the Middle East, and Minerals in the World Economy. Due to budget constraints, detailed mineral trade statistics by country will no longer be included in this publication. However, in the future abbreviated trade data for the major mineral trading countries will be made available by electronic or other means. For information on trade statistics call the Chief, Section of International Data at (202) 501-9700.

The U.S. Bureau of Mines continually strives to improve the value of its publications to users. Therefore, constructive comments and suggestions by readers of the Yearbook are welcomed.

Rhea L. Graham, *Director*

Acknowledgments

The Country Specialists in the Division of International Minerals, U.S. Bureau of Mines, in preparing the International Review regional books of Volume III of the Minerals Yearbook, extensively utilized statistics and data on mineral production, consumption, and trade provided by various foreign government minerals and statistical agencies through various official publications. The cooperation and assistance of these organizations is gratefully acknowledged. Statistical and informational material also were obtained from reports of the U.S. Department of State, from United Nations publications, and from the domestic and foreign technical and trade press. Of particular assistance were the routine and special reports submitted by 10 Regional Resource Officers assigned to minerals and petroleum reporting and by economic and commercial officers and other officials of the Department of State located in U.S. Embassies worldwide. Their contributions are sincerely appreciated. Internal statistical support is provided by the staff of the Section of International Data, Division of Statistics and Information Services. The text and production, structure of the mineral industry, and reserve tables of this volume were prepared by the respective country authors.

The regimes of some countries reviewed in this volume may not be recognized by the U.S. Government. The information contained herein is technical and statistical in nature and is not to be construed as conflicting with or being contradictory of U.S. foreign policy.

George J. Coakley
Chief, Division of International Minerals

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E. Chin's experience with the U.S. Bureau of Mines has been as a research chemist, and as commodity, country, and State analyst and was a career employee of the Bureau.

Chin S. Kuo, mining engineer, has more than 10 years of experience in private industry in Arizona. He is a senior country analyst in the Branch of Asia and the Pacific, specializing in countries of North Asia and Southeast Asia.

Travis Q. Lyday, geologist, since joining the Bureau in 1975 has worked as a mineral land assessment, commodity, and country specialist. Since 1984, he has been a senior country analyst in the Branch of Asia and the Pacific, specializing in countries of Oceania and southeast Asia.

Pui-Kwan Tse, worked as a research chemist for 9 years at Ames Laboratory (Iowa), Brigham Young University, Argonne National Laboratory, and the Naval Research Laboratory, before joining the U.S. Bureau of Mines in 1990. Dr. Tse's research activities included work in environmental waste treatment, solvent extraction, and chromatography. Dr. Tse is a senior country analyst in the Branch of Asia and the Pacific and specializes in China, Hong Kong, Singapore, and Taiwan.

John C. Wu, economist, has nearly to 10 years of experience in private industry as a consulting economist in the areas of natural resources and trade. He has been a senior country analyst in the Branch of Asia and the Pacific, since 1980, specializing in Japan and other countries of North Asia and Southeast Asia.

For comments or further information, please contact:
Chief, the Branch of Asia and the Pacific
The Division of International Minerals
U.S. Bureau of Mines
810 7th St., NW, MS 5205
Washington, DC 20241
Telephone: (202) 501-9691
Fax: (202) 219-2489
Telex: 9102900107 USBM INTL UQ

THE MINERAL INDUSTRY OF THE

ASIA AND THE PACIFIC

By Staff, Branch of Asia and the Pacific

INTRODUCTION[1]

Resources

The countries of Asia and the Pacific, with their large mineral resource base, are significant suppliers of a wide variety of minerals to both regional and world markets. Australia, China, and India dominate the commercial mineral exploitation in the region.

Australia has known reserves of major minerals, which are adequate for both domestic demand, and for exports, and is a significant producer of bauxite; copper; diamond; gold; iron ore; lead; manganese; mineral sands (titaniferrous minerals, monazite, and zircon); nickel; salt; silver; tin; uranium; and zinc. China is the world leader in proven reserves of antimony, barite, ilmenite (titanium), magnesite (magnesium), molybdenum, rare earths, and tungsten. China also has large resources of low-grade iron ore and significant resources of other mineral commodities, such as coal, based on its production and export capabilities. India has significant resources of bauxite, barite, graphite, iron ore, and mineral sands.

Additionally, there are significant resources in Indonesia of bauxite, copper, nickel, and tin; in Malaysia of tin and associated titanium; in Mongolia of copper, fluorspar, and lead-zinc; in New Caledonia of nickel; in New Zealand of gold and iron sands; in North Korea of magnesite; in Papua New Guinea of copper and gold; in the Philippines of copper, chromite, and gold; and in Sri Lanka of gemstones. There also appears to be important mineralization in Burma (Myanmar), Cambodia, Laos, Thailand, and Vietnam. However, the mineral potential in these areas has not yet been fully evaluated.

Hong Kong, Japan, the Republic of Korea, Singapore, and Taiwan have little domestic resources of minerals. Led by Japan, the industrial economies of each of these "tigers" of Asia is dependent on imported raw materials; each country is a significant in regional and international commerce, and each is advanced both technologically and economically.

The overall region lacks large resources of petroleum. There are oil and gas occurrences throughout the region and commercial quantities are recovered in Brunei, China, India, Indonesia, and Malaysia. However, world-class coal deposits are found in Australia, China, India, and Mongolia. There is also coal in Indonesia, which is becoming a major world exporter; anthracite in North Korea; and lignite in New Zealand.

PRODUCTION

The Asia and the Pacific region is a world-class producer of mined commodities and mineral value-added products. However, its production of energy minerals is less than adequate for overall consumption and the projected economic growth of the region.

The countries of Asia and the Pacific produce more than 60% of the world's output of bauxite, fluorspar, graphite, ilmenite, refined tin, and tungsten. Between 40%-60% of the world's output of barite, cement, iodine, iron ore and pig iron, magnesite, manganese, and rutile is from the area. In addition, the region accounts for 15%-40% of the world production of alumina and aluminum metal, mined and refined copper, gold, steel, mined and refined lead, mercury, mined and refined nickel, salt, and mined zinc.

While Asia and the Pacific produces a substantial portion of the mine output of many mineral commodities, its output of crude petroleum and natural gas is only about 10% of world production of each. However, the area is an important producer of coal, and its output of anthracite and bituminous coal is about 90% and about 45%, respectively, of the world production of these commodities.

CONSUMPTION

Australia, China, Japan, and the newly industrialized economies of Asia are playing an increasingly important role in the consumption of minerals and materials. Japan is by far the largest single consumer of fuels, minerals, and metals in the Asia and Pacific region. Most of Japan's consumption of raw materials is for the manufacture of finished goods for domestic consumption and for export. China also is a large consumer of fuels, minerals, and metals, but its production is largely for internal use. Per capita consumption of minerals continues to be very low in China. Other significant consuming nations in the region include Australia, India, Indonesia, Malaysia, the Republic of Korea, Taiwan, and Thailand.

TRADE

To promote economic cooperation, trade, and investment in the Pacific Basin, the member countries of the Asia Pacific Economic Cooperation (APEC) met in 1993 to plan for economic development in the region. APEC is

composed of Australia, Canada, China, Hong Kong, Japan, the Republic of Korea, New Zealand, Papua New Guinea, Taiwan, the United States, plus all the member nations of the Association of Southeast Asian Nation (ASEAN)—runei, Indonesia, Malaysia, Philippines, Singapore, and Thailand. The collective population of APEC accounts for about one-half that of the world.

The countries in the region that are large net exporters of minerals and metals are Australia—alumina, coal, diamonds, ilmenite, refined lead, monazite, rutile, zinc, and zircon; Indonesia—bauxite, copper concentrate, nickel matte, LNG, and tin metal; Malaysia—bauxite, LNG, oil, and tin metal; Mongolia—copper and molybdenum concentrates and fluorspar; New Zealand—aluminum, iron sand, and steel semi-manufactures; and the Philippines—chromite, copper concentrate, and nickel. China historically exports antimony, barite, refractory bauxite, fluorspar, magnesite, rare earths, talc, and tungsten. However, it makes external shipments of petroleum refinery products to obtain foreign exchange currency. Hong Kong and Singapore lack significant mineral resources and are city states featuring major free trade zones. Their respective economies rely on commerce and trade. Singapore is a financial and service center for petroleum and mining activities in Southeast Asia. Japan, the Republic of Korea, and Taiwan are importers of raw materials—fuels and mineral products—that are used in the production of finished manufactures for export.

OUTLOOK

The outlook for mineral development in Asia and the Pacific continues to grow with changes in investment climate in Burma, Mongolia, and Vietnam. There is potential for petroleum and natural gas finds in coastal Asia, particularly in the South China Sea—Burma, China, and Vietnam. Environmental constraints to development are growing in the area, and parts of the region continue to have civil unrest. However, there is potential for an increase in hard rock mining in Australia, Burma, China, India, Mongolia, Papua New Guinea, Thailand, and Vietnam.

The mining and mineral processing industries of the region are sizable, especially in China and Japan. Moreover, the output of these industries will continue to expand in India, the Republic of Korea, Mongolia, and the countries of IndoChina and ASEAN. Taiwan will continue to seek overseas processing facilities to meet the needs of its economy.

Fueled by strong gross domestic product growth rates, the consumption of minerals, metals, and fuels will expand in the countries of Asia and the Pacific in the manufacture of value-added goods for each country's domestic market, in addition to the world market. Because of vibrant growth and trade, the countries of Asia and the Pacific will play an important role in the world economy in the foreseeable future.

[1]E. Chin and Pui-Kwan Tse.

SELECTED GENERAL SOURCES OF REGIONAL INFORMATION

Barclays Bank International, London
ABECOR Group Country Reports.
British Broadcasting Corp., London:
Summary of World Broadcasts, Far East Weekly Economic Report.
British Sulphur Corp. Ltd., London:
Nitrogen, bimonthly.
Phosphorus and Potassium, bimonthly.
Sulphur, bimonthly.
Fairchild Publications, New York: American Metals Market, daily.
Far Eastern Economic Review, Hong Kong: Asia Yearbook.
Far Eastern Economic Review, Hong Kong: Weekly Review.
IBJ Associates, Surrey, England:
International Bulk Journal, monthly.
International Bauxite Association (IBA), Kingston Jamaica: IBA Quarterly Review.
International Lead and Zinc Study Group (ILZSG), London: ILZSG annual report.
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International Tin Council, London: Tin International, quarterly.
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Transactions, monthly.
Bulletin.
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Metal Bulletin Journals Ltd., London: Metal Bulletin, semiweekly, and Metal Bulletin Monthly.
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International Petroleum Encyclopedia, annual.
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and Gas Journal, monthly.
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U.S. Department of Commerce: Bureau of the Census, Washington, DC: U.S. trade statistics.
International Trade Administration, Washington, DC: Foreign Economic Trends and Their Implications for the U.S., International Marketing Information Series.
U.S. Department of State: Periodic Reporting on Select Minerals Industry by the American Embassies.
U.S. Joint Publications Research Service, Arlington, Virginia: Foreign Broadcast Information Service Regional Publications, weekly.
World Bank, Washington, DC: Bank news releases.
World Bureau of Metal Statistics, London: World Metal Statistics Yearbook.

TABLE 1

ASIA AND PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1993

(Thousand metric tons unless otherwise specified)

Country	Aluminum			Barite	Cement	Coal		Copper	
	Bauxite	Alumina	Metal			Anthracite	Bituminous	Mine, Cu content	Refined, primary
Afghanistan	—	—	—	2	115	—	180	5	—
Australia	41,681	12,575	1,381	11	5,500	—	223,898	335	247
Bangladesh	—	—	—	—	275	—	—	—	—
Bhutan	—	—	—	—	130	—	—	—	—
Brunei	—	—	—	—	—	—	—	—	—
Burma	—	—	—	10	400	—	56	7	—
Cambodia	—	—	—	—	—	—	—	—	—
China	3,500	1,820	1,220	1,900	356,000	220,000	920,000	340	450
Christmas Island	—	—	—	—	—	—	—	—	—
Fiji	—	—	—	—	81	—	—	—	—
Hong Kong	—	—	—	—	1,712	—	—	—	—
India	5,223	1,800	425	400	52,000	—	220,000	58	36
Indonesia	1,320	—	206	—	18,934	—	27,583	299	—
Japan	—	327	18	—	88,046	—	7,217	10	1,091
Korea, North	—	—	—	110	17,000	71,000	—	16	22
Korea, Republic of	—	—	—	(1)	47,000	9,443	—	(1)	218
Laos	—	—	—	—	7	—	—	—	—
Malaysia	69	—	—	12	8,806	—	264	25	—
Mongolia	—	—	—	—	270	—	500	117	—
Nauru	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	180	—	—	—	—
New Caledonia	—	—	—	—	90	—	—	—	—
New Zealand	—	—	268	—	600	—	2,800	—	—
Pakistan	5	—	—	26	8,321	—	3,305	—	—
Papua New Guinea	—	—	—	—	—	—	—	204	—
Philippines	—	—	—	500	6,500	—	1,531	136	172
Singapore	—	—	—	—	1,900	—	—	—	—
Solomon Islands	—	—	—	—	—	—	—	—	—
Sri Lanka	—	—	—	—	676	—	—	—	—
Taiwan	—	—	—	—	23,971	—	328	—	—
Thailand	—	—	—	42	23,000	24	—	—	—
Vietnam	—	—	—	—	3,000	6	—	—	—
Total	51,798	16,522	3,518	3,013	664,514	300,473	1,407,662	1,552	2,236
Share of world total percent	[6]49	38	18	62	51	90	45	17	21
United States	W	5,290	3,695	315	72,400	4,322	576,652	1,801	1,577

See footnotes at end of table.

TABLE 1—Continued

ASIA AND PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1993

(Thousand metric tons unless otherwise specified)

Country	Fluorspar	Gold Mine, Au content[2]	Graphite	Iodine	Iron			Lead		Manganese	
					Ore, gross weight	Pig	Steel, crude	Mine, Pb content	Refined, primary	Magnesite	Mine, Mn content
Afghanistan	—	—	—	—	—	—	—	—	—	—	—
Australia	—	247	—	—	120,534	6,766	7,277	505	221	261	865
Bangladesh	—	—	—	—	—	—	32	—	—	—	—
Bhutan	—	—	—	—	—	—	—	—	—	—	—
Brunei	—	—	—	—	—	—	—	—	—	—	—
Burma	—	1	—	—	—	—	—	3	2	—	(1)
Cambodia	—	—	—	—	—	—	—	—	—	—	—
China	2,400	160	310	(1)	234,660	87,300	88,680	338	370	1,500	5,400
Christmas Island	—	—	—	—	—	—	—	—	—	—	—
Fiji	—	4	—	—	—	—	—	—	—	—	—
Hong Kong	—	—	—	—	—	—	350	—	—	—	—
India	20	2	64	—	61,000	15,400	18,500	40	20	500	660
Indonesia	—	42	—	(1)	341	—	1,948	—	—	—	—
Japan	—	9	—	6	11	73,738	99,623	16	212	—	(1)
Korea, North	41	5	38	—	10,500	6,600	8,100	80	75	1,600	—
Korea, Republic of	(1)	25	78	—	219	22,000	33,000	15	88	—	—
Laos	—	—	—		—	—	—	—	—	—	—
Malaysia	—	4	—	—	223	—	1,800	—	—	—	—
Mongolia	180		—	—	—	—	—	—	—	—	—
Nauru	—	—	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	—	—	—	—	—	25	—
New Caledonia	—	—	—	—	—	—	—	—	—	—	—
New Zealand	—	11	—	—	2,000	—	850	—	—	—	—
Pakistan	5	—	—	—	—	1,200	1,100	—	—	4	—
Papua New Guinea	—	61	—	—	—	—	—	—	—	—	—
Philippines	—	16	—	—	—	—	250	—	—	1	14
Singapore	—	—	—	—	—	—	—	—	—	—	—
Solomon Islands	—	(1)	—	—	—	—	—	—	—	—	—
Sri Lanka	—	—	3	—	—	—	—	—	—	—	—
Taiwan	—	—	—	—	—	6,116	12,038	—	—	—	—
Thailand	53	—	—	—	450	—	800	14	—	—	4
Vietnam	—	—	—	—	—	—	190	—	—	—	—
Total	2,699	587	493	6	429,938	219,120	274,538	1,011	988	3,891	3,891
Share of world total percent	67	25	67	36	43	43	38	35	33	[6]37	54
United States	60	331	—	2	55,651	48,155	88,793	362	346	W	—

See footnotes at end of table.

TABLE 1—Continued

ASIA AND PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1993

(Thousand metric tons unless otherwise specified)

Country	Mercury, mine, Hg content[2]	Mica	Nickel		Petroleum crude[4]	Natural Gas[5]	Salt	Tin[2]	
			Mine, Ni content	Refined[3]				Mine, Sn content	Refined, primary
Afghanistan	—	—	—	—	—	2,700	12	—	—
Australia	—	—	65	50	181	24,448	7,699	8,042	222
Bangladesh	—	—	—	—	1	5,974	340	—	—
Bhutan	—	—	—	—	—	—	—	—	—
Brunei	—	—	—	—	66	9,600	—	—	—
Burma	—	—	(1)	—	5	1,200	260	500	150
Cambodia	—	—	—	—	—	—	40	—	—
China	650	—	33	32	1,058	17,000	29,530	49,000	51,500
Christmas Island	—	—	—	—	—	—	—	—	—
Fiji	—	—	—	—	—	—	—	—	—
Hong Kong	—	—	—	—	—	—	—	—	—
India	—	—	—	—	190	13,000	9,502	—	—
Indonesia	—	—	66	37	558	75,376	650	30,415	30,415
Japan	—	—	—	50	6	2,203	1,381	—	804
Korea, North	—	—	—	—	—	—	590	—	—
Korea, Republic of	—	8	—	—	—	—	750	—	—
Laos	—	—	—	—	—	—	8	300	—
Malaysia	—	5	—	—	234	23,500	—	10,384	40,700
Mongolia	—	—	—	—	—	—	18	150	—
Nauru	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	—	—	7	—	—
New Caledonia	—	—	98	11	—	—	—	—	—
New Zealand	—	—	—	—	13	11	80	—	—
Pakistan	—	—	—	—	21	16,524	909	—	—
Papua New Guinea	—	—	—	—	—	—	—	—	—
Philippines	—	—	10	—	3	—	535	—	—
Singapore	—	—	—	—	—	—	—	—	—
Solomon Islands	—	—	—	—	—	—	—	—	—
Sri Lanka	—	(1)	—	—	—	—	43	—	—
Taiwan	—	10	—	9	(1)	573	176	—	—
Thailand	—	—	—	—	10	8,500	300	6,400	7,700
Vietnam	—	—	—	—	—	—	350	3,500	2,500
Total	650	23	272	189	2,346	200,609	53,180	108,691	133,991
Share of world total percent	[6]25	12	[6]33	34	10	9	29	[6]61	73
United States	W	88	NA	—	2,499	519,519	38,710	W	—

See footnotes at end of table.

TABLE 1

ASIA AND PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1993

(Thousand metric tons unless otherwise specified)

Country	Titanium		Tungsten mine, W content[2]	Zinc	
	Ilmenite	Rutile		Mine, Zn content	Refined, primary
Afghanistan	—	—	—	—	—
Australia	1,764	185	23	980	290
Bangladesh	—	—	—	—	—
Bhutan	—	—	—	—	—
Brunei	—	—	—	—	—
Burma	—	—	270	2	—
Cambodia	—	—	—	—	—
China	160	—	20,000	900	838
Christmas Island	—	—	—	—	—
Fiji	—	—	—	—	—
Hong Kong	—	—	—	—	—
India	320	14	3	104	115
Indonesia	—	—	—	—	—
Japan	—	—	66	119	609
Korea, North	—	—	1,000	210	200
Korea, Republic of	—	—	200	28	272
Laos	—	—	—	—	—
Malaysia	289	—	(1)	—	—
Mongolia	—	—	250	—	—
Nauru	—	—	—	—	—
Nepal	—	—	—	—	—
New Caledonia	—	—	—	—	—
New Zealand	—	—	—	—	—
Pakistan	—	—	—	—	—
Papua New Guinea	—	—	—	—	—
Philippines	—	—	—	—	—
Singapore	—	—	—	—	—
Solomon Islands	—	—	—	—	—
Sri Lanka	77	3	—	—	—
Taiwan	—	—	—	—	—
Thailand	2	(1)	100	70	62
Vietnam	—	—	—	15	10
Total	2,612	202	21,912	2,428	2,396
Share of world total percent	6 73	6 44	6 74	35	54
United States	W	W	W	513	253

W Withheld to avoid disclosing company proprietary data.
[1]Less than 1/2 unit.
[2]Metric tons.
[3]Includes Ni content of intermediate products but excludes ferroalloy.
[4]Million 42-gallon barrels.
[5]Million cubic meters.
[6]Excludes U.S. production.

TABLE 2

ASIA AND THE PACIFIC: CONSUMPTION OF SELECTED METALS, 1993

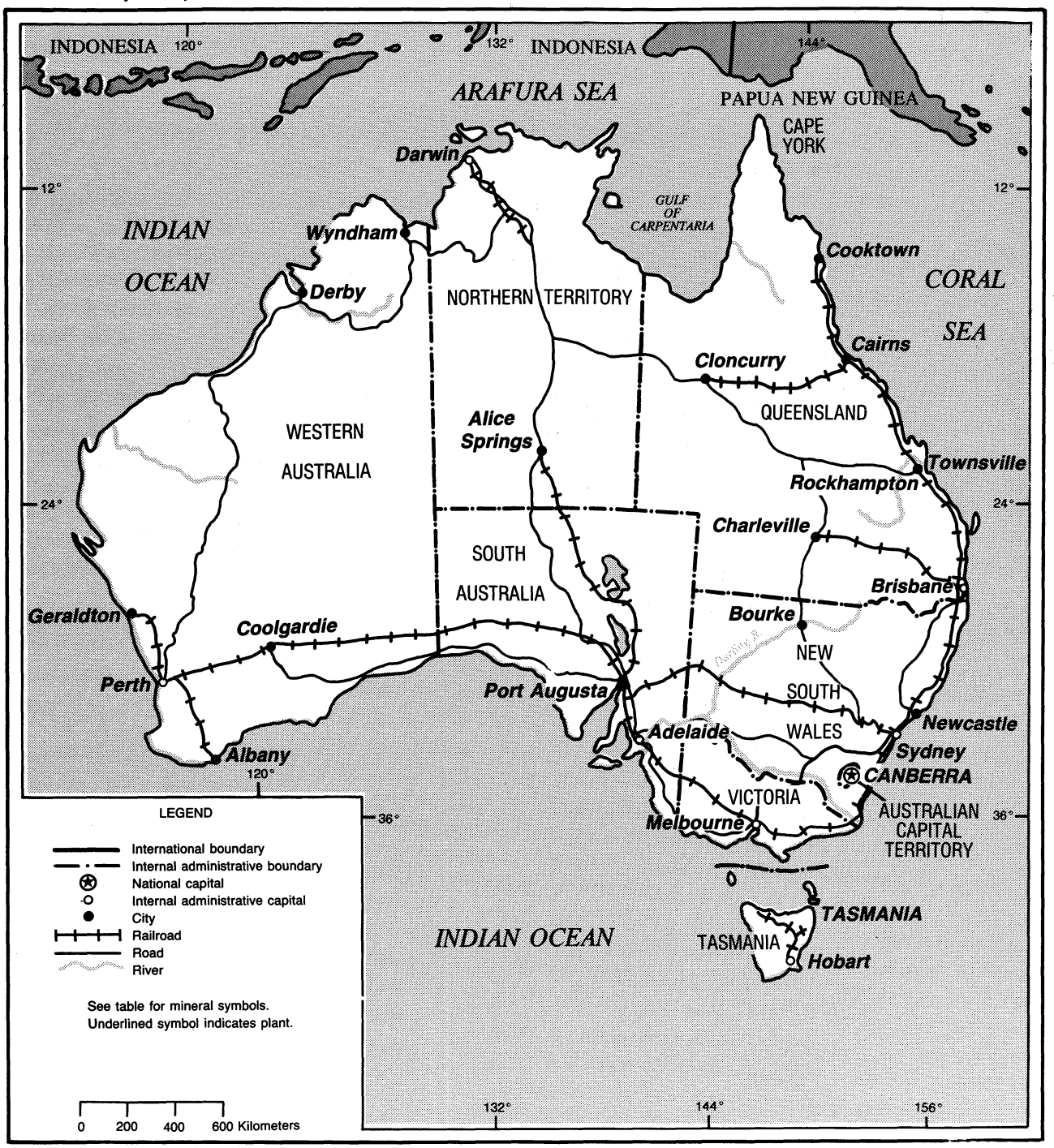
Country	Aluminum, primary	Cadmium	Copper, refined	Lead, refined	Nickel	Tin, refined	Zinc, slab
Australia	339,500	24	62,000	62,000	1,500	300	222,400
China	1,318,000	NA	942,300	304,900	45,000	21,000	NA
Hong Kong	NA	NA	NA	NA	NA	5,200	1,000
India	475,300	446	140,000	80,000	13,200	1,400	150,000
Indonesia	NA	NA	NA	NA	NA	1,500	48,000
Japan	2,174,800	5,527	1,384,100	371,300	143,500	28,700	718,700
Korea, North	NA	NA	NA	1,000	NA	NA	NA
Korea, Republic of	557,100	380	399,800	177,000	NA	9,100	311,200
Malaysia	NA	NA	NA	NA	NA	5,200	NA
New Zealand	27,100	NA	4,400	5,000	300	NA	15,400
Philippines	NA	NA	16,000	NA	NA	200	38,800
Singapore	NA	NA	NA	NA	NA	NA	30,000
Taiwan	299,100	20	477,200	100,700	NA	8,100	170,500
Thailand	NA	NA	NA	50,000	NA	5,000	78,500
Asia (other)	614,000	119	400,000	162,400	51,900	300	65,600
Total	5,804,900	6,516	3,825,800	1,314,300	255,400	86,000	1,850,100
Percent world consumption	38	40	41	26	33	50	28
United States	4,877,100	2,699	2,367,900	1,308,000	132,200	35,300	1,141,000

NA Not available.

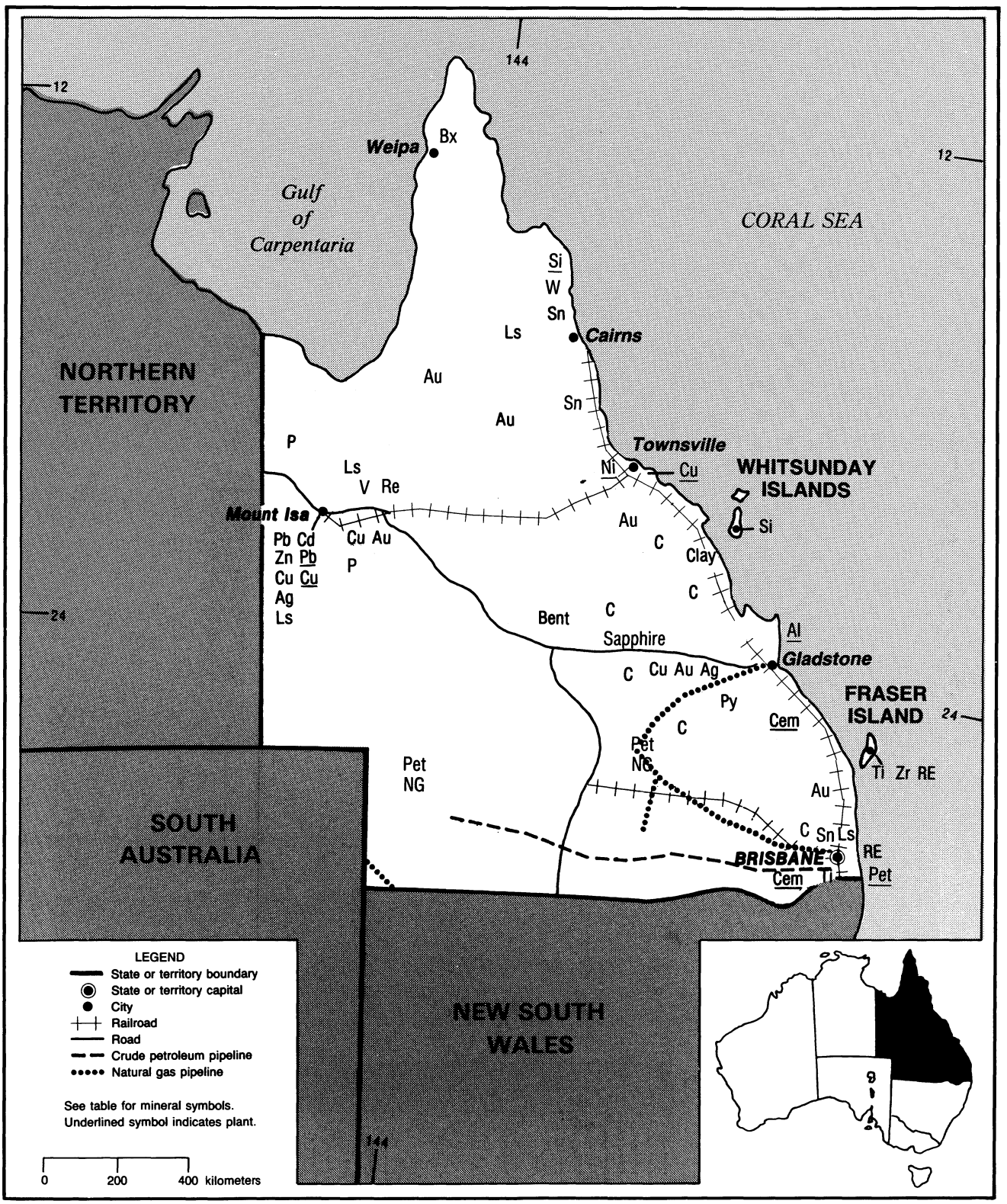
Source: World Metal Statistics, Sept. 1994.

AUSTRALIA

AREA 7,686,850 km² **POPULATION 17.6 million**

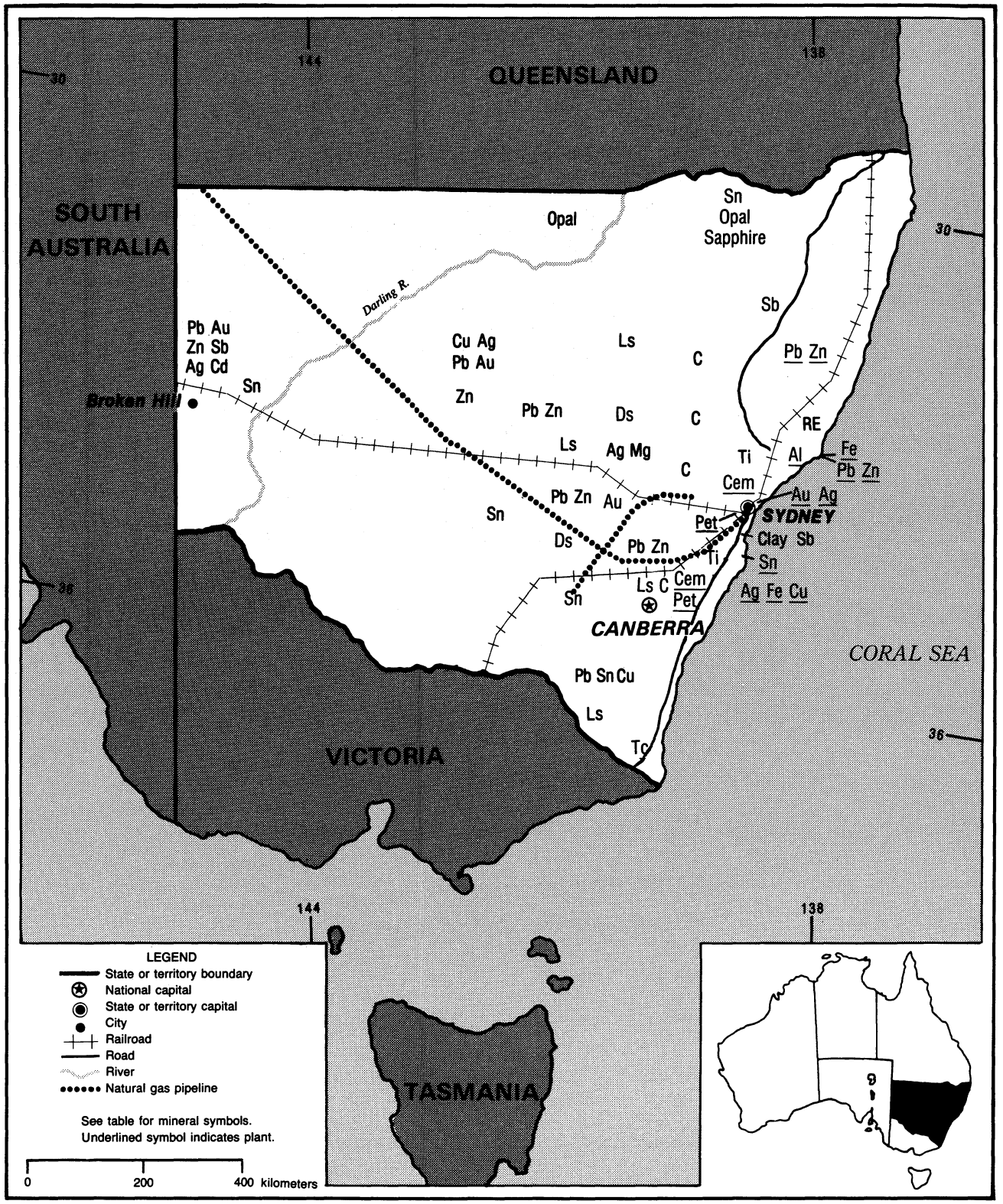


QUEENSLAND



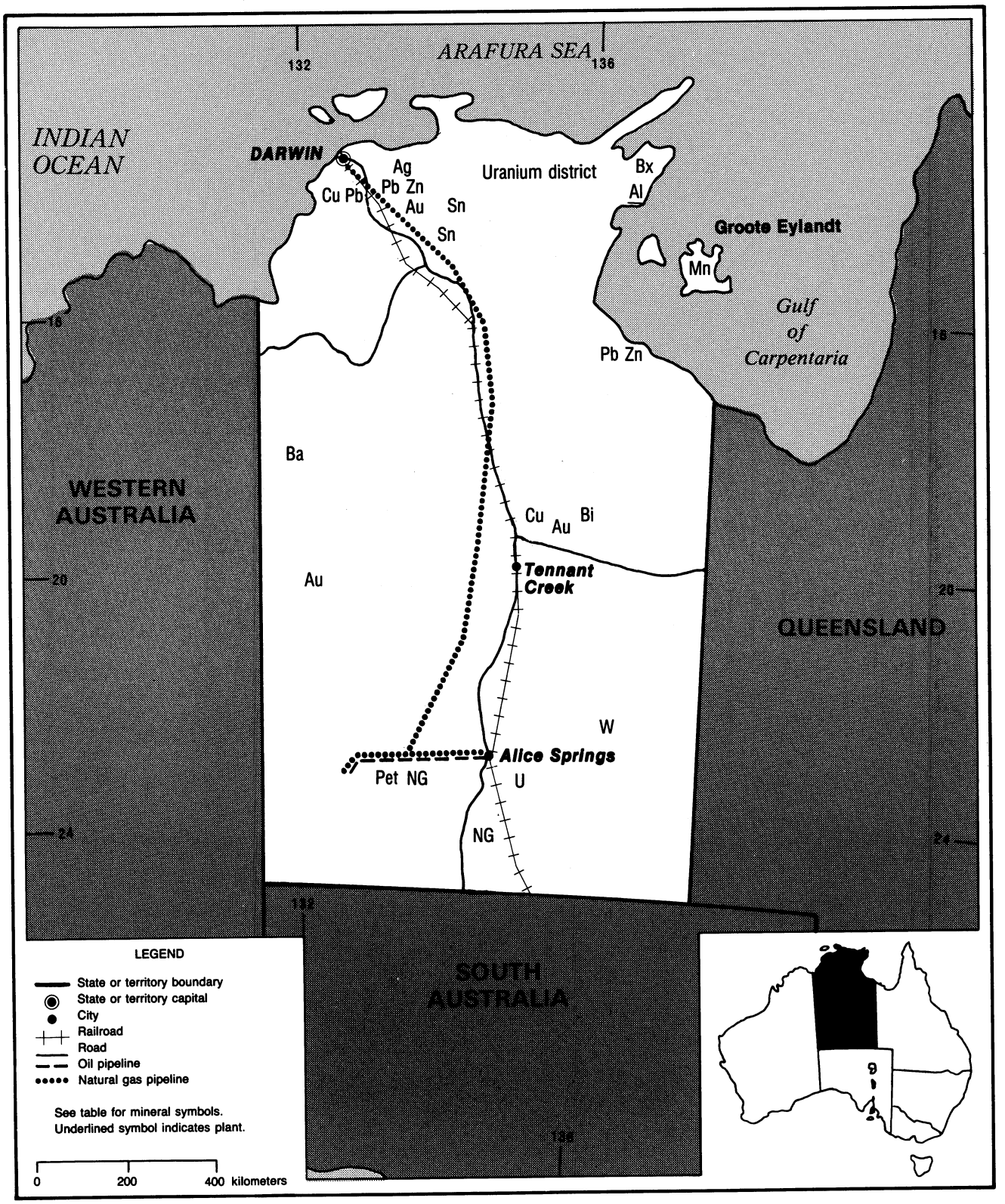
MINERAL SITES AND PIPELINES OF THE STATE OF QUEENSLAND

NEW SOUTH WALES



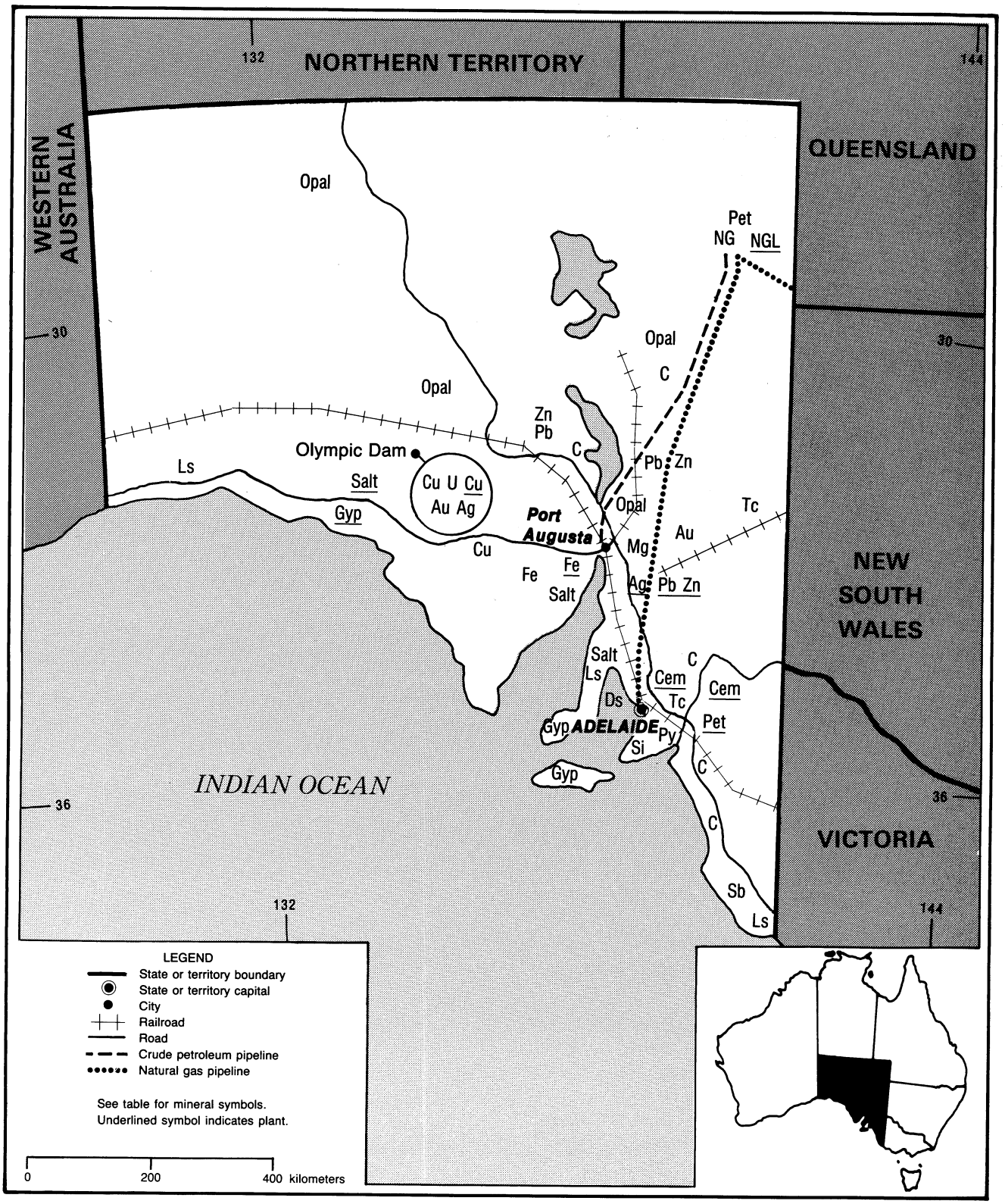
MINERAL SITES AND PIPELINES OF THE STATE OF NEW SOUTH WALES

NORTHERN TERRITORY



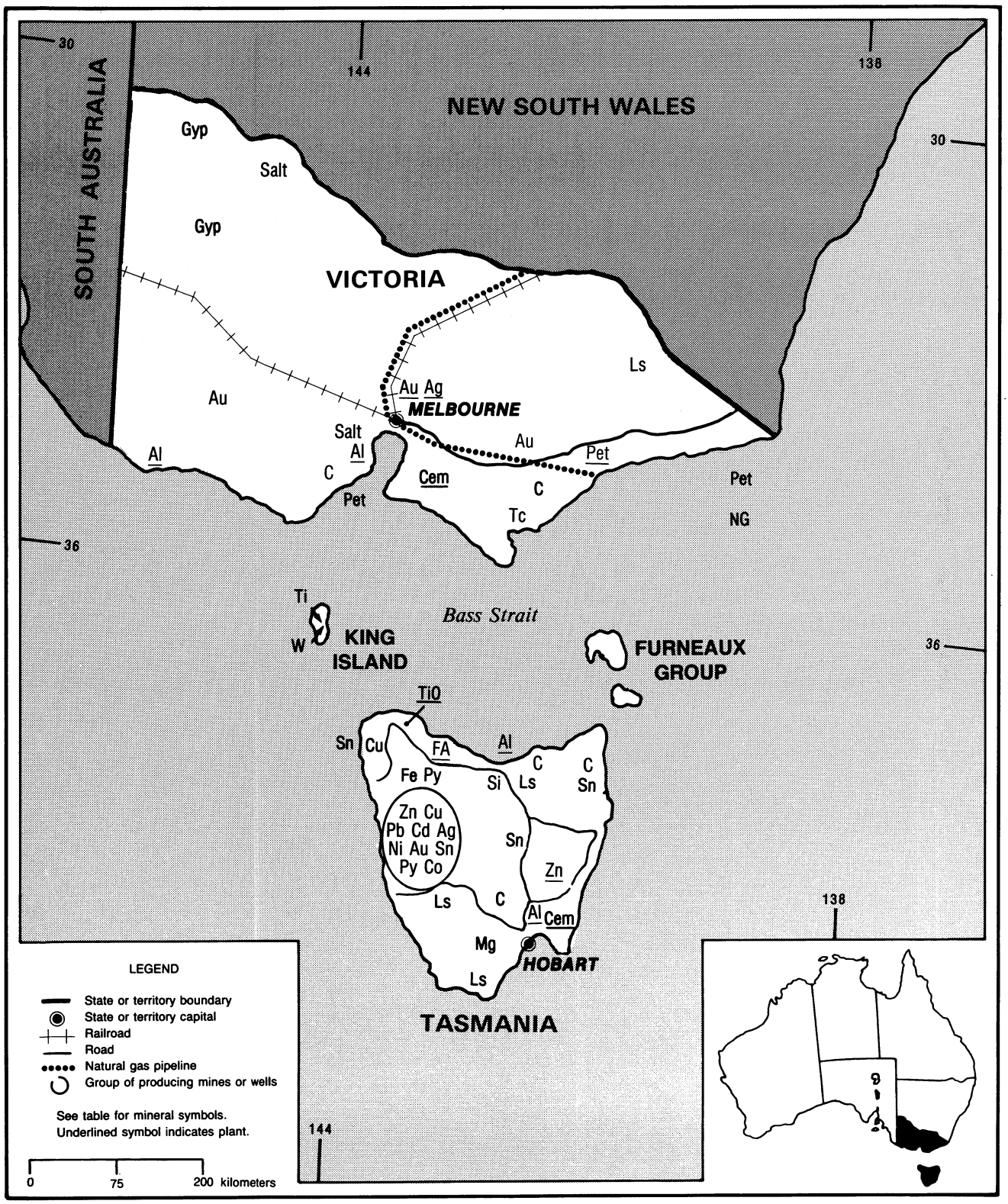
MINERAL SITES AND PIPELINES OF THE TERRITORY OF THE NORTHERN TERRITORY

SOUTH AUSTRALIA



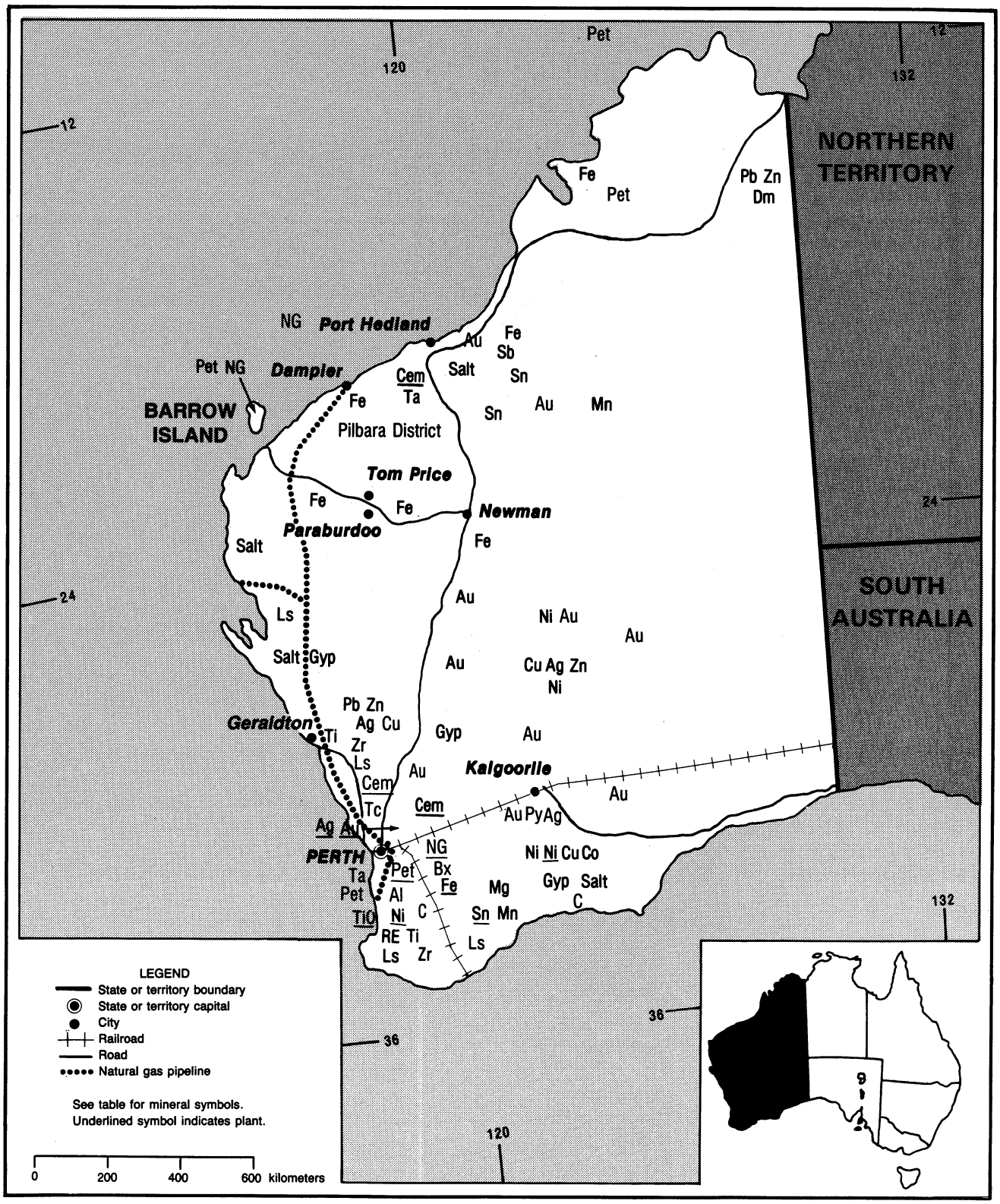
MINERAL SITES AND PIPELINES OF THE STATE OF SOUTH AUSTRALIA

TASMANIA AND VICTORIA



MINERAL SITES AND PIPELINES OF THE STATES OF TASMANIA AND VICTORIA

WESTERN AUSTRALIA



MINERAL SITES AND PIPELINES OF THE STATE OF WESTERN AUSTRALIA

THE MINERAL INDUSTRY OF

AUSTRALIA

By Travis Q. Lyday

Australia is one of the world's leading mineral producers, although the country is relatively unimportant as a mineral consumer. Moreover, Australia also is one of the few developed countries in the Western World that is a net exporter of mineral fuels. The country's energy resource base includes huge reserves of coal, natural gas, and uranium, considerable quantities of liquefied petroleum gas, and major amounts of raw materials such as oil shale, which could provide a basis for synthetic fuel development. The only significant mineral fuel in which Australia is currently not self-sufficient is petroleum. Nevertheless, Australia still produces about 75% of its crude oil requirements domestically.

Although the Australian mineral industry dates back to coal and copper mining shortly after the first European settlements in 1788, the country's mining industry did not come into its own until the gold rushes of the 1850's in New South Wales (NSW), Queensland (QLD), Victoria (VIC), and Western Australia (WA); the lead-silver-zinc discoveries at Broken Hill, NSW, in 1883; and the Mount Isa, QLD, lead-silver-zinc and copper finds 50 years later. Further discoveries followed, and since the mid-1960's, Australia has become a major world producer of a number of minerals. The minerals industry, the largest primary sector of the economy, remained heavily export-oriented, with about 80% of the value of its mineral production destined for international markets.[1] Mineral exports were heavily concentrated into just four commodity groups: alumina, aluminum, and bauxite; coal; gold; and iron ore.

Ownership of mineral rights in Australia is divided between State ownership in State onshore areas and Commonwealth ownership in Territories and in offshore areas. However, the Commonwealth's responsibility for minerals in the Northern Territory (NT), except for uranium, has been transferred to the Government of the NT.

GOVERNMENT POLICIES AND PROGRAMS

The ruling by the Australian High Court in its landmark Mabo decision in June 1992 recognized that the common law of Australia had not automatically extinguished native title under the principle of Terra Nullius, or unoccupied land. Although the judgment overturned established law, the Court's decision did not evaluate the acquisition of sovereignty by the Crown. Thus, titles issued by the State governments, including mining tenements and leases, potentially became subject to native claims where the Aboriginal people had maintained their connection with the land continuously through the years of European settlement; such title had not been terminated by valid acts of Imperial, Colonial, State, Territory, or Commonwealth governments; and the content of native title could be determined according to the traditional laws and customs of the Aboriginal people involved.

The Mabo decision created a new form of property law for the country, which was applicable retroactively, overturning more than 200 years of established property law in Australia. Consequently, uncertainty resulted, encouraging the filing of suits dealing with native title claims in all six States and both Territories.

Because of the potentially serious impact of the Mabo decision throughout Australia, especially on the minerals industry, the Government introduced and passed the Native Title Act 1993 near yearend. The act confirmed recognition of the High Court's decision on native title and provided the mechanism to maintain a system of land management to make it work through clear and predictable rules. The act was to take effect January 1, 1994.

PRODUCTION

The value of minerals produced in Australia in fiscal year 1993,[2] the latest period for which official data were available, increased to $20.8 billion,[3] 2% above that of the previous fiscal year and almost 8% of the gross domestic product (GDP) of $270.5 billion. This increase followed a 1% decline in fiscal year 1992. Metallic mineral production contributed an estimated 40% of this total, followed by petroleum (crude oil, natural gas, and natural gas liquids) production, 30%; coal production, 25%; and industrial minerals production, including clays, construction materials, dimension stone, peat, and salt, 5%. The value of downstream production, including smelting and refining, increased about 4% in fiscal year 1993 over that of fiscal year 1992.

Australia remained the world's leading producer of alumina, bauxite, diamond, ilmenite, mined lead, monazite, opal, rutile, sapphire, and zircon in calendar year 1993. The country also ranked among the world's first 4 producers of aluminum, cobalt, gold, iron ore, uranium, and mined zinc, and within the top 10 producers of mined antimony, coal, mined copper, manganese, mined nickel, salt, mined silver, and mined tin. *(See table 1.)*

TRADE

Australia continued to rely heavily on the export of the majority of its mineral production to bolster economic growth. The value in fiscal year 1993 of its mineral exports rose by 5.6%, to a record high $21.7 billion, more than 60% of all commodity exports for the year.[4] Australia was the premier exporter of alumina, coal, ilmenite, iron ore, refined lead, monazite, rutile, and zircon. By using its plentiful resources of energy minerals (coal, liquefied natural gas, and uranium), Australia also continued to be a net exporter of mineral fuels, thus enabling the country to retain a favorable trade balance in energy products.

Coal remained Australia's largest mineral export earner in 1993, followed by refined gold, iron ore, and bauxite, respectively. Annually, Australia exports about 70% of its coal production, accounting for one-third of world trade; more than 90% of the gold it produces; about 90% of its iron ore production, representing about 30% of world trade; and 80% of its aluminum production, composing more than 10% of world trade. The richness and diversity of the Australian minerals sector provided a significant portion of the GDP, contributing more than 40% of the country's export earnings in fiscal year 1993.

STRUCTURE OF THE MINERAL INDUSTRY

The Australian minerals industry covers just about the whole spectrum of minerals, from major industrial minerals (ilmenite, rutile, and zircon), base metals (copper, lead, and zinc), ferrous metals (iron ore, manganese, and nickel), nonferrous metals (aluminum and tin), precious metals (gold and silver), fuel minerals (coal and uranium), to gemstones (diamond, opal, and sapphire). It is one of the world's principal producers and suppliers of ores, concentrates, and refined metals. Australia is estimated to rank fourth in the world in the value of nonfuel mineral production after the former U.S.S.R., the United States, and the Republic of South Africa. The value of mineral production, including fuels, was estimated to rank eighth in the world.

The Australian mining industry is based on a system of free enterprise, with private companies involved in exploration, mine development, production, mineral processing, and marketing. A number of foreign companies in mineral ventures in Australia are affiliates or subsidiaries of U.S. companies. Foreign companies currently control a majority of the mining, smelting, and refining sectors and a significant portion of the petroleum and natural gas sectors.

Many of Australia's mineral industries are fully integrated, producing ores, concentrates and other intermediate products (e.g., alumina), and refined metal or other end products (e.g., cut-and-polished gem diamond) within the country. In 1993, there were six alumina refineries and aluminum smelters each; three principal copper smelters and refineries each; two principal gold refineries; four principal lead-zinc smelters and/or refineries; one manganese ferroalloys plant; one nickel smelter and two nickel refineries; three principal crude steel plants; one primary tin smelter and refinery each and two secondary tin refineries; and two silver refineries. Australia had eight principal petroleum refineries.

Ownership of the mineral resources in Australia generally resides with the State or Territory in which they occur. The major exception concerns offshore resources beyond the territorial limit, where Commonwealth jurisdiction prevails. Thus, the individual States and Territories administer the minerals industries within their own borders, including registering of land titles; issuing exploration and development permits; overseeing mining operations, including administration of inspections; assuring compliance with health, safety, and environmental regulations; and levying royalties and taxes.

However, the Federal Government can restrict mineral exports for the good of the country and therefore has de facto control over most mineral production. *(See table 2.)*

COMMODITY REVIEW

Metals

Antimony.—The only antimony mine operating in Australia remained New England Antimony Mines NL's operations near Hillgrove, an old gold mining area in northern NSW. In addition to about 3,000 mt/a of antimony concentrate, the mine also produced minor amounts of gold. New England Antimony is a subsidiary of Hillgrove Gold Ltd.

Bauxite, Alumina, and Aluminum.—Australia continued to be the unchallenged world leader in bauxite production for the 23d consecutive year, producing more than 40% of the production of market economy countries. All mining continued to be from the opencut operations at Weipa on the western flank of the Cape York Peninsula in the far north of QLD; the Gove operation across the Gulf of Carpentaria in northeastern Arnhem Land, NT; and from the mines south of Perth in the Darling Ranges, WA. Although substantial bauxite deposits are known to occur bordering the Admiralty Gulf at Cape Bougainville and in the nearby Mitchell Plateau area of the Kimberley region of northern WA, their remoteness from energy supplies and infrastructure has thus far blocked development.

Australia also continued to dominate in 1993 the world alumina market, producing from six refineries more than one-third of Western World production. The NT and QLD each had one refinery; the remaining four were in WA.

Australia was a significant supplier of aluminum as well. Aluminum was produced at six smelters, two each operating in NSW and VIC, and one each operating in QLD and Tasmania (TAS).

Bauxite, together with its value-added products alumina and aluminum, remained in 1993 for the fifth consecutive year the nation's next most important

export after coal.

Alcoa of Australia Ltd. announced in April its decision to further upgrade its Wagerup alumina refinery, WA. The expansion project was scheduled to be completed by midyear 1994, increasing the capacity by about 200,000 tons, to 1.7 Mmt/a.[5]

As a result of the Australian High Court's Mabo decision, a claim on behalf of the Wik Aboriginal people was filed in midyear against Comalco Ltd. over a portion of the bauxite mining leases at Weipa that it has held since 1958. Although the Native Title Act 1993 apparently was thought eventually to validate the company's claim to the Weipa mining leases, Comalco subsequently delayed until the new year a decision whether to proceed with construction of a third potline at its 50%-owned Boyne Island aluminium smelter. The Weipa deposits supplied all the bauxite for the alumina refinery at Gladstone, QLD, which in turn fed the Boyne Island facility. Comalco also owned 30.3% of the Gladstone refinery.[6] The suit was pending in Federal Court at yearend.

Comalco announced in midyear that it likely would close its aging Bell Bay, TAS, aluminium smelter by 2001 following collapse of negotiations with the State over acquisition of part of the State's electricity grid. The purchase would have secured an electricity supply for Comalco at competitive prices, enabling it to proceed with plans to refurbish and expand the smelting facility. Comalco's power contract with the State's Hydro-Electric Commission expires in 2001.[7]

Cobalt.—Australia remained the fourth largest producer of cobalt in the world, with output principally produced as a byproduct of nickel mining and processing. Australia's leading producer was the Queensland Nickel Joint Venture (QNJV), which processed laterite nickel-cobalt ores at its Yabulu nickel refinery near Townsville, QLD. The QNJV comprised QNI Ltd., 80%, and Nickel Resources North Queensland Pty. Ltd., an agency of the QLD Government and also a QNI shareholder, holding a 20% interest in the QNJV. The refinery's feedstock was ore imported from Gebe Island, Indonesia, and La Grande Terre, the main island of New Caledonia, that was blended with domestically produced ores mined at QNJV's newly opened Brolga Mine and from stockpiled ore from the Greenvale Mine, both in QLD. The Greenvale Mine, 225 km west of Townsville at Marlborough, was depleted in 1992, and the facilities and equipment not necessary for the operation of the adjacent Brolga Mine were sold in May 1993.

Copper.—Mine production of copper in Australia continued to be from operations that produced other metals, either as the primary product or as a coproduct. The most notable copper-producing operations were at Mount Isa (Hilton copper-lead-zinc mine), QLD, and Roxby Downs Station (Olympic Dam copper-gold-uranium mine), South Australia (SA).

Western Mining Corp. Holdings Ltd. (WMC) became in March full owner of the huge Olympic Dam operation when it purchased for $240 million the 49% equity held by BP Australia Ltd. WMC also paid an additional $190 million to settle previous obligations made by BP to fund the project's construction. WMC's decision to take full control of the project that it discovered in 1975 meant that the earlier offer, which was conditionally accepted at yearend 1992, for the BP share by South Africa's Minorco PLC was nullified because WMC had a preemptive right to purchase BP's share at the same price and conditions as those offered by another potential buyer.[8] BP's share had been on the market since the company sold most of its mining interests to RTZ Corp. of the United Kingdom in 1990. In April, WMC announced the go-ahead for a $55 million mine expansion that will increase copper production capacity at Olympic Dam from 66,000 mt/a to 84,000 mt/a by 1996.

WMC was developing its 60,000-mt/a opencut Nifty Mine in the Great Sandy Desert of WA at a cost of about $44 million. The operation was to produce about 16,000 tons of copper cathode using a combination of heap leaching and solvent extraction-electrowinning methods.

Gold.—Despite the gold industry's predictions of dire consequences, the removal of the tax-exempt status on gold mining profits continued to have little or no adverse impact on production since the tax was implemented January 1, 1991. Indeed, production reached a new record high in 1993, making Australia the world's third largest producer after South Africa and the United States. Australia produced in 1993 more than 10% of the world's gold production.

WA remained the premier gold-producing State, again producing about 75% of the country's production, followed by QLD and the NT. Gold was mined in all States and Territories except the Australian Capital Territory (ACT). Table 3 shows the 15 largest gold mines in Australia in 1993.

Renison Goldfields Consolidated Ltd. (RGC) began development in November of the first gold mine in TAS in 50 years at its wholly owned property at Henty, 25 km north of Queenstown on the west coast of TAS. RGC projected that development of the underground mine would cost about $39 million, coming on-stream in 1996 at a planned production rate of about 3,100 kg/a of gold.[9]

ICI Australia announced at yearend plans to expand sodium cyanide production at its Yarwun plant near Gladstone, QLD, that only was opened in midyear. The initial 25% lift in capacity was to lay the foundation for a later 40,000 mt/a increase in production, all of which was expected to be sold for use in the domestic market. ICI Australia was Australia's only integrated producer of solid sodium cyanide.[10]

Iron Ore.—Australian iron ore production continued to be heavily concentrated in the Hamersley Range of the Pilbara District, WA, which accounted for more than 96% of the country's production. Iron ore also was produced at the Iron Duke and Iron Knob

Mines by BHP Steel Ltd. in the South Middleback Ranges near Whyalla, SA, and at the Savage River Mine in northwestern TAS.

Australia retained its position in 1993 as the world's leading iron ore exporter, beating out Brazil for the third consecutive year. As a world producer, Australia ranks fourth after the former U.S.S.R., China, and Brazil.

After several months of negotiations, Portman Mining Ltd. entered in October into a $19 million 60-40 joint venture with China's largest iron and steel producer, Anshan Iron and Steel Corp., to redevelop the old Koolyanobbing Mine, 430 km east of Perth, WA. Under the agreement, Anshan will underwrite the project by purchasing all the iron ore fines produced, estimated at 1.1 Mmt/a for 20 years, at the Koolyanobbing Mine as well as all the concentrate produced, about 0.6 Mmt/a for its 6-year life, from the beneficiation of low-grade ore stockpiles left from previous operations at Cockatoo Island off the northern coast of WA, which Portman holds. Iron ore sales from the Koolyanobbing Mine to Anshan's steel mill were expected to be about $25 million per year. Total sales from the mine, which also will produce about 0.9 Mmt/a of lump ore for sale to other customers, were expected to be almost $37 million per year. Shipments from Koolyanobbing to Anshan were expected to commence in July 1994 through the WA port of Esperance.[11]

BHP Iron Ore Ltd. despatched on December 1 its first trainload of high-grade hematite iron ore from the new operation at Yarrie to the port facilities at Finucane Island, Port Hedland, 200 km distant. The Yarrie Mine, an extension or satellite mine of the former project at Mount Goldsworthy, has a capacity of 5 Mmt/a of iron ore and was developed in less than 9 months to largely replace production from the nearby Nimingarra-Sunrise Hill operations, 25 km to the northwest at Shay Gap, which were running out of high-grade ore. Some facilities, including the crushing plant and stockpiling and train loading facilities, at Shay Gap were closed earlier in the year, refurbished, and then relocated to support the Yarrie operation.[12]

BHP Iron was upgrading its Yandi Mine from about 6.5 Mmt/a to 10 Mmt/a. Yandi's design when it started in March 1992 included an allowance to expand its original capacity of 5 Mmt/a, including duplicating the existing tertiary processing circuit by installing new conveyors, two extra screens, and four gyratory crushers.

Lead and Zinc.—Most lead and zinc ore mined in Australia continued to be from operations that produced both because the two metals commonly occur in associated minerals in the same ore bodies. Zinc was the main product of all the lead-zinc mines in operation during the year.

Australia was the most important lead concentrate producer in the industrialized world, with about 20% of the total, and was second in the production of zinc concentrate, with about 15% of the total, in 1993. In refined production, Australia ranked fifth in zinc and eighth in lead, excluding lead bullion.

Mining at Pasminco Ltd.'s North opencut mine at Broken Hill, NSW, ceased in February after 90 years of operation and all remaining production was from the South Mine, or southern underground operations. A restructuring of the southern operations early in the year were able to maintain the 2.2-Mmt annual ore production level of the combined northern and southern operations.

Development of the McArthur River mining project began in midyear. The McArthur River deposit is in the northeast corner of the NT, about 100 km south of the Gulf of Carpentaria and 230 km west of the QLD border. It is considered to be one of the largest zinc-lead-silver deposits in the world. The project was to start producing a high-grade bulk concentrate containing 160,000 tons of zinc and 45,000 tons of lead by early 1996. The concentrate was to be transported 120 km by road to the Gulf of Carpentaria coast and barged to ships moored 30 km offshore for export to overseas smelters.[13]

Manganese.—Groote Eylandt Mining Co. Pty. Ltd.'s (GEMCO) mine on the northwest portion of Groote Eylandt, in the west of the Gulf of Carpentaria, was the second biggest mining operation in the NT, after the Gove bauxite mine, and was the world's third largest manganese producer, representing about 10% of production. GEMCO ships annually about one-quarter of its more than 2 Mmt of concentrate to the ferromanganese plant operated by Tasmanian Electro Metallurgical Co. Pty. Ltd. (TEMCO) at Bell Bay, TAS. Both GEMCO and TEMCO are wholly owned subsidiaries of BHP Minerals Ltd. Smaller quantities were used in BHP's electrolytic manganese dioxide plant at Newcastle, NSW, for the production of high-grade material used in long-life batteries.

BHP Minerals and Elkem of Norway, the world's largest producer of manganese alloys, signed in March the contract they negotiated in July 1992. Under the agreement, Elkem's two Norwegian manganese alloys plants will come under the ownership of a new joint venture, Elkem Mangan KS, 51%-owned by Elkem and the balance by BHP Minerals. Groote Eylandt Manganese Sales Pty. Ltd. (GEMS), a new joint-venture company 51%-owned by BHP Minerals and the remainder by Elkem, will be established to supply Elkem's manganese requirements. GEMS will supply ore from the Groote Eylandt Mine to the two alloys plants on a production cost basis for an initial period of 10 years.[14]

Portman Mining Ltd., Australia's only other manganese miner, managed and operated the Woodie Woodie operation near Nullagine in the Pilbara region, WA. Portman processed during 1993 more than 650,000 tons of ore mined from the Austin, Cracker, and Greensnake pits at the Woodie Woodie project.

Mineral Sands.—Australia's mineral sands industry included the mining and processing of high concentrations of the heavy minerals ilmenite, leucoxene, monazite, rutile, and zircon. Australia

was the world's leading producer and exporter of mineral sands. In 1993, Australia's mineral sands industry produced about 40% of the ilmenite, 35% of the rutile, 50% of the zircon, and a substantial portion of the world's monazite.

Rutile is an important titanium dioxide (TiO_2) material, and ilmenite is an important feed material for the production of synthetic rutile, or TiO_2 slag. Ilmenite and rutile are valued for their TiO_2 content, which is used as white pigment in the paint, paper, plastics, printing, and rubber industries and as the source for titanium metal used in the aerospace and medical industries. Monazite is a source of rare-earth oxides that are used in electronics and other high-technology products. Zircon is widely used in ceramics, refractories, and foundry applications.

Nickel.—The Australian nickel mining industry in 1993 consisted of several mines operating near the communities of Forrestania, Kambalda, and Leinster in WA and a new operation near Marlborough, QLD, that supplanted the depleted Greenvale Mine. Downstream processing occurred at the Kalgoorlie Smelter in WA and at refineries at Kwinana, WA, and Yabulu, near Townsville, QLD. In 1993, Australia was the world's fifth largest producer of mined nickel in the world.

WMC remained the country's dominant nickel miner and main nickel metal producer. WMC operated nickel sulfide mines and mills centering on the Kambalda and Leinster regions of WA; the nickel smelter at Kalgoorlie, WA; and the refinery at Kwinana, WA. Kambalda Nickel Operations (KNO), a division of WMC, operated several mines in the Kambalda area, and Leinster Nickel Operations (LNO), also a division of WMC, operated the Rocky's Reward and Perseverance Mines near Leinster. The inactive Leinster Mine, an underground mine originally named Agnew and mothballed in 1986, was the LNO's namesake.

During the year, WMC completed the program of doubling mine output to 2 Mmt/a of ore from its LNO to produce 30,000 mt/a of contained nickel; increased capacity to 42,000 mt/a at the Kwinana refinery south of Perth; and upgraded the Kalgoorlie smelter to a capacity of 37,000 mt/a. The proposed upgrading of the KNO, suspended at yearend 1992, was apparently resolved when the WA government amended near yearend the WA Mines Regulation Act to allow continuous working rosters in existing underground mines. Kambalda had been working on a 5-day-workweek basis, unlike all the other States. Output was expected to reach 35,000 mt/a by mid-1995.

The QNJV brought on-stream its Brolga Mine, 225 km west of Townsville at Marlborough, QLD, to replace the depleted Greenvale Mine. The ores mined at Brolga and recovered from stockpiles at the adjacent Greenvale deposit were blended with ores imported from the Oeboelie Mine on Gebe Island, Indonesia, and from three suppliers on La Grande Terre, the main island of New Caledonia, to use as feedstock for QNJV's Yabulu nickel refinery. The facilities and equipment at Greenvale not necessary for use at Brolga were sold in May 1993.

Commercial production began early in the year at the Forrestania nickel project, about 375 southeast of Perth, WA. The project, consisting of three mines (Cosmic Boy, Digger Rocks, and Flying Fox), was operated by Outokumpu Oy of Finland as a 50-50 joint venture between its two wholly owned subsidiaries, Outokumpu Australia Pty. Ltd. and Outokumpu Western Australia Pty. Ltd. Outokumpu was producing about 8,000 mt/a of nickel in concentrate that was shipped through the port of Esperance to Outokumpu's Harjavlta refining facilities in Finland.

WMC purchased in February the 50% share held by Finland's Outokumpu Metals and Resources Oy to become sole owner of the Mount Keith project, 90 km from Leinster in WA. The Mount Keith deposit, regarded as the world's largest low-grade sulfide nickel deposit, was under development to mine about 6.6 Mmt/a of ore. WMC also contracted to sell 50% of production, about 14,000 mt/a of nickel in concentrate, to Outokumpu Metals and Resources for a period of 10 years. Production was scheduled to commence in 1995.[15]

Development of Dominion Mining Ltd.'s Yakabindie nickel mine in WA was still under consideration at yearend. The proposed mine was to produce a ferronickel oxide product as a charge nickel feedstock for the stainless steel industry. Dominion was seeking a joint-venture partner prior to commencing development.

Platinum-Group Metals.—No Australian mines were primary producers of platinum-group metals (PGM) in 1993, although minor production by WMC continued at Kambalda as a byproduct of the nickel operations. PGM, mainly platinum and palladium, were recovered at the Port Kembla, NSW, refinery-smelter complex from the processing of byproduct copper sulfide residue produced at the Kwinana nickel refinery. PGM also were contained in nickel matte produced for export at the Kalgoorlie smelter.

Steel.—BHP Steel was the only integrated steel producer in Australia during the year. BHP Steel's contribution to total world steel output was relatively small, having just three integrated steelworks that produced less than 1% of world production. BHP Steel's plants are at Newcastle and Port Kembla in NSW and Whyalla in SA.

Compact Steel Ltd. and its major shareholders decided in October to proceed with plans for constructing a 1.7-Mmt/a integrated steel plant at Rockingham, south of Perth near Collie in WA, following the State government's decision to proceed with construction of a 300-MW power station at Collie. The major shareholders, in addition to the Australian firms Clough Engineering and the private investor group TSI Unit Trust, included Italy's largest private steelmaker, Falck; Siemens of Germany; and Voest Alpine of Austria that developed the Corex technology. If the

plant is built, it would be the world's first integrated mill to use Corex ironmaking technology combined with the latest thin slab casting techniques and an on-site power station. The powerplant is vital to the project because it will use exhaust gases from the Corex ironmaking process as well as natural gas to power the turbines, thus providing low-cost energy.[16]

Tantalum.—Australia continued in 1993 to be a major producer of tantalum concentrates. Production was from Gwalia Consolidated Ltd.'s Greenbushes Mine, about 250 km south of Perth in WA and the largest producer of tantalite in the world, and from the Wodgina Mine, 100 km south of Port Hedland, WA, managed by Pan West Tantalum Pty. Ltd., a subsidiary of Pancontinental Mining Ltd., in equal joint venture with Goldrim Mining Australia Ltd.

After closing its soft-rock open pit mine and treatment plant in December 1992, Gwalia Consolidated commissioned early in 1993 its $17.5 million plant for the treatment of hard-rock tantalite ore obtained from mining fresh pegmatite at the Greenbushes site.

Pancontinental was planning to develop in early 1994 the joint venture's Tabba Tabba alluvial deposit about 50 km southeast of Port Hedland and also to proceed with a feasibility study for developing the Mount Cassiterite deposit to augment declining grades at the Wodgina Mine. The Mount Cassiterite deposit is about 1 km south of the Wodgina lode operations.[17]

Tin.—RGC's Renison Mine near Zeehan, TAS, remained the world's largest hard-rock underground tin mine and Australia's main tin producer. Gwalia Consolidated's Greenbushes Mine in southwestern WA also produced tin as a coproduct of its spodumene and tantalite mining.

RGC put on hold the construction of a 600-m shaft for accessing the Rendeep deposit lying beneath existing workings at the northern end of the mine.

Industrial Minerals

Diamond.—Australia has been the world's largest producer of natural diamond since 1986, but only a relatively small portion of its output has been of gem quality, reflecting the country's sixth ranking in 1993 in terms of value of world diamond production. The majority of production was derived from operations at the mammoth Argyle Mine in the Kimberley region of WA, which again retained its position, for the eighth consecutive year, as the world's biggest single-mine producer of diamond with output equivalent to about 40% of world production. About 5% of production was of gem quality, including a small proportion of the highly valued intensely pink stones that generated about 50% of revenues; 40% was near-gem quality that produced about 45% of revenues; and 55% was industrial quality that contributed just 5% of revenues.[18]

Argyle Diamond Mines Pty. Ltd. (ADM), a wholly owned subsidiary of CRA Ltd., was the management company and operator of Argyle Diamond Mines Joint Venture's (ADMJV) Argyle Mine. ADMJV itself comprised CRA, 59.7%, and Ashton Mining Ltd., 40.3%. ADMJV continued to sell most of its gem quality and about 80% of its near-gem quality white diamonds to De Beers' Central Selling Organization (CSO) under a 5-year marketing contract signed in mid-1991 through Argyle Diamond Sales Pty. Ltd. (ADS), a company jointly owned by CRA, 60%, and Ashton, 40%. ADMJV retained the right to sell the few handfuls of the very rare, intensely pink *Argyle Pink* diamonds unique to the Argyle Mine, as well as the more common yellow to brown stones, which are marketed as *Argyle Champagne* or *Argyle Cognac* diamonds, depending upon the specific color. These diamonds were cut and polished using traditional techniques and automated laser cutting machines at ADS's small facility in West Perth. Most of the remaining portion of the near-gem quality and all of the industrial-grade stones were sold on the open market through ADS's Antwerp, Belgium, office. A small proportion of the near-gem quality material was toll processed overseas through ADS before being sold on the open market.

ADM's second major upgrade of the processing plant, the first since 1990, to increase capacity was progressing smoothly at yearend for a probable May 1994 commissioning. The program to increase the capacity a further 2 Mmt/a at a cost of approximately $70 million was to ensure that the level of diamond production would be maintained, offsetting the expected decline in ore grade with depth of the AK-1 lamproite pipe.

Australia's only other commercial diamond operation, Poseidon Bow River Diamond Mine Ltd.'s Bow River Mine 25 km northeast of the Argyle Mine, also produced another record-high output in 1993. More than 1 million carats was recovered for the second year in a row, maintaining an annual production increase each year since operations began in 1988. All of Bow River's output was marketed under a sales agreement with the CSO. About 20% of the Bow River production was gem quality, with a consistent percentage of the intensely pink diamonds, and 80% was industrial grade. Bow River diamonds were recovered from buried diamondiferous gravels that originated from the AK-1 pipe.

The Phillips Range diamond joint venture sold in October its first run-of-mine diamonds recovered from gravels and associated near-surface weathered material from the Aries kimberlite pipe, approximately 200 km west of the Argyle Mine. The sale consisted of 1,105 stones weighing 250 carats. The joint venture was doing limited diamond production using a recommissioned diamond recovery plant, treating about 100 mt/hr of gravel, and had been conducting a drilling and exploration program to delineate the diamondiferous Aries pipe and Nyairgul Creek alluvial deposits for a study to determine appropriate mining methods. The joint venture's preliminary plans for 1994 included adding a crushing circuit, increasing sorting capacity, and developing a combination of open cut and underground declines to enable trial

mining and bulk sampling of the unweathered kimberlite. The joint venture consisted of Triad Minerals NL, with a 62% share; Black Hill Minerals Ltd., 24%; and Cliff Resources Corp. of Canada, 14%.[19]

Gemstones.—Australia was the world's leading producer of precious opal in 1993, accounting for about 95% of the world's production. About one-half of Australia's opal was produced from fields at Andamooka, Coober Pedy, and Mintabie in SA. Most was hand-mined, either from an open cut or an underground drive. Opal in NSW mostly was mined at Lightening Ridge, the world's major source of the highly prized and valuable black opal, although a small amount still was produced at White Cliffs, the site of opal discovery in 1889. A small quantity of opal also was produced in western QLD.

Australia continued to be the world's leading producer of natural sapphire. Australia's commercial sapphire production was mined from alluvial deposits in the Inverell-Glen Innes (New England) region of northern NSW and the Rubyvale-Anakie region of central QLD. Australia was supplying up to about 70% by volume of the world's sapphire until 1987 when the Thai Government lifted restrictions on mechanized mining of Thailand's sapphire and production was increased substantially in China and Nigeria. Consequently, Australia's share of world supply gradually has declined so that in 1993 it produced only about 25% to 30% by volume of the world's rough sapphire output. Most of the uncut gems still were exported to Thailand, the recognized world leader for cutting and marketing.

Australia continued to produce almost all the world's chrysoprase from the Marlborough, QLD, deposit and has the world's largest known resource of nephrite jade at Cowell, on the Eyre Peninsula in SA. In addition, Australia also produces other gemstones, including agate, amethyst, chiastolite, emerald (aquamarine), garnet, rhodonite, topaz, tourmaline, turquoise, and zircon.

Salt.—Dampier Salt (Operations) Pty. Ltd. continued to supply more than one-half of Australia's salt exports, 70% of which went to Japan, from its solar operations at Dampier Field, on Mistaken Island near Dampier in the Pilbara area, and Lake Macleod Field, near Carnarvon, both in WA. Indonesia, the Republic of Korea, and Taiwan received the bulk of the remaining exports.

Mineral Fuels

Coal.—Australia retained in 1993 its position as the world's largest exporter of coal, a position it has held since 1984, setting another record of more than 131 Mmt shipped, an increase of 4.4% over that of 1992. Australia controlled about 35% of the world's seaborne coal trade by exporting more than two-thirds of its black coal production. The major market was Japan, which imported almost 50% of Australia's coal exports. The coal industry also remained in 1993 Australia's largest foreign-exchange earner, accounting for more than one-quarter of export revenues from the minerals sector and about 15% of the country's export earnings.

Petroleum and Natural Gas.—Production from Australia's largest energy development undertaking, the massive North West Shelf Gas (NWS Gas) project on the continental shelf about 140 km offshore of Dampier, WA, continued to climb steadily during the year. NWS Gas consisted primarily of providing natural gas to WA through the State Energy Commission of Western Australia (SECWA), supplying liquefied natural gas (LNG) to Japan, and producing gas condensate for domestic and international refineries.

BHP Minerals, Normandy Poseidon Ltd., and WMC tendered in midyear bids to construct the proposed 1,480-km, $365 million Kalgoorlie pipeline to transport natural gas from the Pilbara region of WA to the inland gold and nickel production centers of the State. The project was being touted by the SECWA to almost halve energy costs with the substitution of gas-based energy for diesel-based or coal-based power generation when completed, as well as open up new opportunities for mineral processing. The pipeline will transport gas drawn from the main pipeline between Dampier and Bunbury, through the Pilbara iron ore area, and down through the eastern goldfields to the nickel operations at Kambalda.[20]

The total number of petroleum exploration and development wells drilled during 1993 (178) was 5% more than the number drilled during 1992 (170). The number of onshore exploration wells drilled in 1993 (73) was 7 less than that in 1992 (80). However, the number of offshore exploration wells drilled (49) was 10 more than the number drilled in 1992 (39). The total number of exploration wells drilled in 1993 (122) increased 3% from the number drilled in 1992 (119). The total number of development wells drilled (56) was 5 more than that in 1992 (51), with 35 wells drilled onshore and 21 drilled offshore, compared to 39 and 12 wells, respectively, drilled in 1992. The total meters drilled for exploration and development wells in 1993 (357,027) was 2% less than that drilled in 1992 (365,236). In seismic survey activity during 1993, the total number of line km recorded (162,934) decreased almost 54% compared with that of 1992 (351,999).[21]

Uranium.—The Commonwealth Government's 10-year-old policy of restricting uranium production to three sites remained in effect throughout the year. The mines involved continued to be the operational Olympic Dam Mine in SA and the Ranger Mine in the Alligator Rivers region of the NT. The third permissible site, Queensland Mines Ltd.'s Nabarlek Mine, also in the Alligator Rivers region of the NT, was depleted of reserves and closed in 1988. Thus, the "three mines" policy continued to be in practice a "two mines" policy, as the export permitholders, Energy Resources of Australia Ltd. (ERA) and WMC, were the only ones with viable mines. The Commonwealth Government had de facto control over uranium mining by

controlling the licenses for the export of uranium-bearing ores and by prohibiting further downstream involvement in the nuclear fuel cycle, including enrichment or other value-added processes.

WMC announced in April its decision to proceed with a $55 million expansion of the Olympic Dam Mine at Roxby Downs, 560 km northwest of Adelaide, SA, that will increase ore throughput to the mill from 2.4 Mmt/a to 2.9 Mmt/a, raising uranium oxide production from 1,400 mt/a to 1,500 mt/a.[22] WMC purchased in March BP's 49% interest in the mine under its right of first refusal after Minorco offered to buy BP's share in 1992. All of Olympic Dam's uranium production was sold and exported under long-term contracts to utilities in Europe, Japan, and the United States.

Reserves

Australia has a sound resource base of a diverse range of minerals. It is self-sufficient in most minerals of economic importance. However, in spite of extensive exploration, the country still appears to be deficient in chromite, mercury, mica, PGM, and sulfur. Major minerals with known reserves adequate for domestic demand and exports include bauxite, clays, coal, copper, diamond, gold, iron ore, lead, manganese, mineral sands, natural gas, nickel, salt, silver, tin, uranium, and zinc. *(See table 4.)*

INFRASTRUCTURE

The communications-transportation infrastructure of Australia was well developed. There was 837,872 km of roads, including 243,750 km paved; 228,396 km gravel, crushed stone, or stabilized-soil surface; and 365,726 km unimproved earth. Inland waterways, of which there was about 8,368 km usable for mainly small, shallow-draft craft, were of little importance to the transportation industry.

The Government-owned railway system consisted of 40,478 km of track, 16,201 km of which was standard gauge. There was 1,130 km of electrified rail. A few hundred km of rail was privately owned, most of which served the iron ore industry in WA. There were 243 principal airports with permanent-surface runways out of an aggregate of 481 in the country. International shipping ports included Adelaide, Brisbane, Cairns, Darwin, Devonport, Fremantle, Geelong, Hobart, Launceston, Mackay, Melbourne, Sydney, and Townsville. The merchant marine fleet included 17 petroleum, oils, and lubricant tankers; 3 chemical tankers; 6 liquefied gas tankers; 2 combination ore-oil tankers; and 30 bulk ore freighters.

Pipelines included 5,600 km for natural gas; 2,500 km for crude oil; and 500 km for refined oil products. Electric generating capacity in 1992 was 40 GW.[23]

In remote areas where mines, mills, or smelters are usually located, an individual mining company must provide its own infrastructure, such as housing, roads, railways, port facilities, and various community services.

OUTLOOK

Many sectors of the Australian mining industry, including aluminum, coal, copper, gold, iron ore, lead-zinc, manganese, mineral sands, nickel, and tin, continue to face an uncertain future owing to weak commodity prices, rising costs of production, large inventories on world markets, and/or insufficient infrastructure. However, Australia was expected to continue as a significant world supplier of these and other mineral resources in which it is abundantly endowed well into the 21st century.

Probably the largest single potential detriment to the resource sector in the years ahead is the strong environmental movement in the country. Although ores and processed minerals have been accounting for almost one-half of export income, increasingly strong antimining sentiment continues to impede investment in the mining and minerals sector, with the result that exploration and development activities continue to decrease as they become more difficult to conduct. This will have a very significant effect on the development of large greenfields projects that will be needed to maintain the impetus of the mining and processing sectors.

However, land access may become the biggest issue to threaten the minerals industry in Australia. Access for exploration either already is prohibited or is made difficult over more than 30% of the country's land mass owing to restrictions in certain areas, such as national parks and Aboriginal reserves. The percentage of lands difficult to access likely will increase as land claims increase under the Native Title Act 1993. Restricted access to conduct proper exploration programs because of environmental reasons, land rights issues, or any other reason also will mean even fewer funds will be available for exploration and capital investment, and this eventually will translate into a reduction in production.

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[1]Mining Journal (London). V. 322, No. 8260, Jan. 28, 1994, p. 58.

[2]Australia's fiscal year begins on July 1 and ends on June 30 of the year stated.

[3]Where necessary, values have been converted from Australian dollars (A$) to U.S. dollars at the rate of A $1.00=US$0.73.

[4]Australian Journal of Mining (Richmond North, Australia). V. 8, No. 87, Nov. 1993, p. 43.

[5]Metal Bulletin (London). No. 7772, Apr. 15, 1993, p. 9.

[6]———. No. 7813, Sept. 13, 1993, p. 12.

[7]The Miner (Sydney). Oct. 1993, p. 6.

[8]South-East Asia Mining Letter (Hong Kong). V. 5, No. 5, Mar. 12, 1993, p. 2.

[9]Mining Journal (London). V. 321, No. 8249, Nov. 5, 1993, p. 309.

[10]Australian Mining (Chippendale, New South Wales). V. 85, No. 12, Dec. 1993, p. 7.

[11]South-East Asia Mining Letter (Hong Kong). V. 5, No. 21, Nov. 12, 1993, pp. 3-4.

[12]Australian Mining (Chippendale, New South Wales). V. 86, No. 1, Jan.-Feb. 1994, p. 50.

[13]Metal Bulletin Monthly (London). V. 277, Jan. 1994, p. 67.

[14]Metal Bulletin (London). No. 7773, Apr. 19, 1993, p. 19.

[15]Resource Information Unit Ltd. Register of Australian Mining, 1993/94. 1993, p. 275, Subiaco, Western Australia.

[16]Metal Bulletin (London). No. 7822, Oct. 14, 1993, p. 28.

[17]Work cited in footnote 15, p. 255.

[18]Mining Journal (London). V. 322, No. 8268, Mar. 25, 1994, p. 223.

[19]———. V. 321, No. 8247, Oct. 22, 1993, p. 278.

[20]Australian Journal of Mining (Richmond North, Australia). V. 8, No. 81, June 1993, p. 29.

[21]Bureau of Resource Sciences, Canberra, Australia: Australian Petroleum Exploration and Development Statistics, Feb. 1994, 2 pp.

[22]Metal Bulletin (London). No. 7762, Mar. 8, 1993, p. 12.

[23]U.S. Central Intelligence Agency, Washington, DC: The World Factbook 1993, pp. 23-25.

OTHER SOURCES OF INFORMATION

Agencies

Australasian Institute of Mining and Metallurgy
P.O. Box 122
Parkville, VIC 3052
Australia
Telephone: +61 3 347 3166
Fax: +61 3 347 8525

Australian Bureau of Agricultural and Resource Economics
G.P.O. Box 1563
Canberra, ACT 2601
Australia
Telephone: +61 6 272 2000
Fax: +61 6 272 2001

Australian Geological Survey Organization (formerly Bureau of Mineral Resources, Geology and Geophysics)
G.P.O. Box 378
Canberra, ACT 2601
Australia
Telephone: +61 6 249 9111
Fax: +61 6 249 9999

Australian Gold Mining Industry Council Ltd.
G.P.O. Box 2121T
Melbourne, VIC 3001
Australia
Telephone: +61 3 642 1065
Fax: +61 3 686 9161

Australian Institute of Petroleum Ltd.
257 Collins Street
Melbourne, VIC 3000
Australia
Telephone: +61 3 654 1411
Fax: +61 3 654 1950

Australian Lead Development Association
124 Exhibition Street
Melbourne, VIC 3000
Australia
Telephone: +61 3 654 1611
Fax: +61 3 654 1136

Australian Mineral Industries Research Association Ltd.
128 Exhibition Street
Melbourne, VIC 3000
Australia
Telephone: +61 3 654 8844
Fax: +61 3 654 8661

Australian Mines and Metals Association Inc.
10-16 Queen Street
Melbourne, VIC 3000
Australia
Telephone: +61 3 614 4777
Fax: +61 3 614 3970

Australian Mining Industry Council
P.O. Box 363
Dickson, ACT 2602
Australia
Telephone: +61 6 279 3600
Fax: +61 6 279 3699

Australian Petroleum Exploration Association Ltd.
167 Macquarie Street
Sydney, NSW 2000
Australia
Telephone: +61 2 221 4899
Fax: +61 2 221 4592

Chamber of Mines and Energy of Western Australia Inc.
12 St. Georges Terrace
Perth, WA 6000
Australia
Telephone: +61 9 325 2955
Fax: +61 9 221 3701

Chamber of Mines, Metals, and Extractive Industries of New South Wales
167 Macquarie Street
Sydney, NSW 2000
Australia
Telephone: +61 2 232 8282
Fax: +61 2 232 8275

Coal Corporation of Victoria
128 Exhibition Street
Melbourne, VIC 3000
Australia
Telephone: +61 3 654 6366
Fax: +61 3 650 2305

Commonwealth Scientific and Industrial Research Organization
P.O. Box 53
Parkville, VIC 3052
Australia
Telephone: +61 3 662 7111
Fax: +61 3 662 7196

Department of Primary Industries and Energy
G.P.O. Box 858
Canberra, ACT 2601
Australia
Minister for Primary Industries and Energy
Telephone: +61 6 277 7520
Fax: +61 6 273 4120
Minister for Resources
Telephone: +61 6 277 7480
Fax: +61 6 273 4154

Joint Coal Board
G.P.O. Box 3842
Sydney, NSW 2001
Australia
Telephone: +61 2 248 9686
Fax: +61 2 262 6090

Mineral Resources Tasmania (formerly Tasmanian Department of Mines)
P.O. Box 56
Rosney Park, TAS 7018
Australia
Telephone: +61 02 33 8333
Fax: +61 02 44 2117

New South Wales Department of Mineral Resources
P.O. Box 536
St. Leonards, NSW 2065
Australia
Telephone: +61 2 901 8888
Fax: +61 2 901 8777

Northern Territory Chamber of Mines and Petroleum Inc.
G.P.O. Box 510
Darwin, NT 0801
Australia
Telephone: +61 89 81 4486
Fax: +61 89 41 1625

Northern Territory Department of Mines and Energy
P.O. Box 2901
Darwin, NT 0801
Australia
Telephone: +61 89 89 5460
Fax: +61 89 89 5530

Queensland Coal Board
G.P.O. Box 384
Brisbane, QLD 4001
Australia
Telephone: +61 7 237 1521
Fax: +61 7 221 6759

Queensland Department of Minerals and Energy (formerly Queensland Department of Resource Industries)
61 Mary Street
Brisbane, QLD 4000
Australia
Telephone: +61 7 237 1435
Fax: +61 7 229 7770

Queensland Mining Council
60 Edward Street
Brisbane, QLD 4000
Australia
Telephone: +61 7 221 8722
Fax: +61 7 229 4564

South Australian Chamber of Mines and Energy
P.O. Box 493
Glenside, SA 5065
Australia
Telephone: +61 8 379 9711
Fax: +61 8 379 1142

South Australian Department of Mines and Energy
P.O. Box 151
Eastwood, SA 5063
Australia
Telephone: +61 8 274 7500
Fax: +61 8 272 7597

Uranium Information Center
G.P.O. Box 1649N
Melbourne, VIC 3001
Australia
Telephone: +61 3 867 1544
Fax: +61 3 967 5816

Victorian Chamber of Mines Inc.
53 Queen Street
Melbourne, VIC 3000
Australia
Telephone: +61 3 629 1851
Fax: +61 3 629 8603

Victorian Department of Energy and Minerals (formerly part of the Department of Manufacturing and Industry Development)
176 Wellington Parade
East Melbourne, VIC 3002
Australia
Telephone: +61 3 651 7799
Fax: +61 3 651 7937

Western Australian Department of Minerals and Energy (formerly Western Australian Department of Mines)
100 Plain Street
East Perth, WA 6004
Australia
Telephone: +61 9 222 3333
Fax: +61 9 222 3430

Western Australian Department of Resources Development (formerly Western Australian Department of State Development)
170 St. Georges Terrace
Perth, WA 6000
Australia
Telephone: +61 9 327 5555
Fax: +61 9 327 5500

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Canberra: Quarterly Mineral Statistics, quarterly.
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TABLE 1
AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Aluminum:							
Bauxite, gross weight	thousand tons	38,584	41,391	r40,510	r39,746	41,681	2 42,000
Alumina	do.	r10,823	r11,197	r11,703	r11,803	2 12,575	2 212,780
Metal, refined:							
Primary	do.	1,244	1,234	r1,228	r1,236	2 1,381	2 1,415
Secondary		48,400	32,900	r29,600	r40,000	40,000	55,000
Antimony, Sb content of ores and concentrates		1,360	1,420	1,500	r1,701	1,700	1,700
Bismuth, mine output, Bi content e		500	400	400	—	—	1,400
Cadmium:							
Mine output, Cd content		1,685	2,100	2,500	2,516	2,500	2,800
Metal, smelter (refined)		696	638	1,076	r1,001	2 996	1,100
Cobalt: e							
Mine output, analytic content of:							
Nickel ore		r 2 1,912	1,400	1,100	700	700	2,500
Nickel concentrate		r 2 266	r400	r500	r500	500	525
Zinc concentrate		r 2 90	70	70	70	70	100
Total		r 2 2,268	r1,870	r1,670	r1,270	1,270	3,125
Recovered cobalt, including that from imported source material		1,100	r1,200	r1,400	r1,600	1,700	1,800
Columbium-tantalum concentrate, gross weight		555	529	703	r656	2 495	675
Copper:							
Mine output, Cu content	thousand tons	r295	r327	r320	r378	335	400
Metal:							
Smelter:							
Primary	do.	r203	192	r195	r304	2 247	325
Secondary e		10,000	10,000	10,000	10,000	10,000	10,000

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Copper—Continued:							
Refined:							
Primary	thousand tons	r220	r250	r244	r271	2309	325
Secondary		35,000	24,000	35,000	32,000	25,000	35,000
Gold:							
Mine output, Au content	kilograms	203,563	244,137	234,218	r243,400	247,196	248,000
Metal:							
Refined:							
Primary	do.	197,382	254,583	e250,000	e250,000	2283,726	285,000
Secondary	do.	18,220	18,670	e20,000	r e8,000	28,345	20,000
Iron and steel:							
Iron ore:							
Gross weight	thousand tons	105,810	110,508	117,134	r117,170	2120,534	2138,000
Fe content	do.	67,313	69,766	68,732	r72,650	274,767	XX
Metal:							
Pig iron	do.	6,094	6,125	5,647	r6,388	26,766	6,775
Ferroalloys:e 3							
Ferromanganese		267,000	70,000	r45,000	55,000	75,000	80,000
Metal:							
Ferroalloys:e 3							
Steel, crude	thousand tons	6,735	6,666	6,018	r6,868	27,277	7,300
Semimanufactures e		6,500	3,000	3,000	3,000	21,788	6,500
Lead:							
Mine output, Pb content	thousand tons	495	r570	r579	r572	505	600
Metal:							
Primary:							
Bullion, for export	do.	r176	r172	r172	r231	2224	225
Refined	do.	r190	212	220	r215	2221	225
Total	do.	r366	r384	r392	r446	2445	450
Secondary excluding remelt	do.	r15	r17	r19	r17	17	25
Manganese ore (metallurgical):							
Gross weight	do.	2,124	1,920	1,482	1,200	21,789	24,500
Mn content e	do.	1,011	909	701	570	865	XX
Nickel:							
Mine output, Ni content	do.	r65	67	69	r58	265	86
Metal, smelter (refined Ni and Ni content of oxide)	do.	44	r43	r50	r50	50	50
Platinum-group metals:e							
Palladium, Pd content	kilograms	400	400	400	400	400	525
Platinum, Pt content	do.	100	100	100	100	100	130
Total	do.	500	500	500	500	500	655
Rare-earth metals, monazite concentrate:e							
Gross weight		13,000	11,000	7,000	7,000	8,000	18,750
Monazite content		r7,150	r6,050	r3,850	r3,850	4,400	XX
Silver:							
Mine output, Ag content		1,075	r1,173	1,180	r1,248	21,162	1,250
Metal, refined		376	419	e400	e400	2345	425

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
METALS—Continued							
Tin:							
Mine output, Sn content[4]		7,709	7,377	5,700	6,400	[2]8,042	8,525
Metal, refined:							
Primary		424	312	268	[e]250	[2]222	2,900
Secondary[e]		300	200	300	250	250	450
Titanium concentrates, gross weight:							
Ilmenite	thousand tons	1,696	1,602	1,363	1,500	1,764	[2]1,950
Leucoxene		18,000	19,000	18,000	22,000	19,000	32,125
Rutile		243,000	245,000	201,000	190,000	185,000	[2]320,000
Tungsten, mine output, W content		1,371	1,086	237	[e]160	[2]23	1,975
Uranium, mine output, U content		3,656	3,529	3,776	[r e]4,000	[2]2,256	4,325
Zinc:							
Mine output, Zn content	thousand tons	803	[r]940	[r]1,024	[r]1,008	980	1,025
Metal, smelter:							
Primary	do.	[r]291	304	322	[r]329	290	350
Secondary		5,500	4,500	4,500	4,500	4,500	5,500
Zirconium concentrates, gross weight	thousand tons	511	497	292	283	[2]409	525
INDUSTRIAL MINERALS							
Abrasives, natural:[e]							
Beach pebble		1,000	1,500	2,000	2,000	2,000	2,000
Garnet		16,000	20,000	25,000	25,000	25,000	25,000
Barite[e]		11,000	11,000	11,000	11,000	11,000	19,550
Cement, hydraulic	thousand tons	6,900	7,068	6,108	5,412	5,500	7,075
Clays:[e]							
Bentonite and bentonitic clay		35,000	35,000	35,000	35,000	35,000	40,000
Brick clay and shale	thousand tons	8,500	8,000	8,000	8,000	8,000	8,500
Cement clay and shale	do.	500	500	500	500	500	500
Damourite clay		100	100	100	100	100	2,200
Fire clay [5]		25,000	25,000	25,000	25,000	25,000	40,000
Fuller's earth (attapulgite)[e]		15,000	20,000	15,000	15,000	15,000	20,000
Kaolin and ball clay[5]		185,000	200,000	190,000	180,000	180,000	220,000
Other[5]	thousand tons	1,000	1,000	1,000	1,000	1,000	2,000
Diamond:							
Gem	thousand carats	17,540	17,331	17,978	17,750	18,844	18,850
Industrial	do.	17,540	17,331	17,978	22,250	23,032	23,050
Total	do.	35,080	34,662	35,956	40,000	[2]41,876	41,900
Diatomite[e]		12,000	10,000	11,000	11,000	11,000	12,000
Feldspar including nepheline syenite[e]		12,500	16,000	16,000	15,000	15,000	16,000
Gem stones, other than diamond:[e]							
Opal	value, thousands	[r 2]$92,000	[r 2]$86,700	$85,000	$85,000	$90,000	XX
Sapphire	do.	[r 2]$63,50	[r 2]$40,600	[r]$40,000	[r]$40,000	$40,000	XX
Other	do.	$3,000	$800	$900	$900	$1,000	XX
Total	do.	[r]$158,500	[r]$128,100	[r]$125,900	[r]$125,900	$131,000	XX
Gypsum[e]	thousand tons	1,800	1,800	2,000	2,000	2,000	1,950
Kyanite[e]		500	750	800	800	800	1,275
Lime[e]		1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Magnesite e		55,000	60,000	100,000	r262,000	260,600	262,000
Nitrogen: N content of ammonia		343,600	385,300	r414,100	r391,900	398,000	414,000
Perlite, crude e		5,000	5,000	5,000	5,000	5,000	5,000
Phosphate rock		8,000	r14,000	4,000	r2,000	2,000	34,000
Salt	thousand tons	7,069	7,227	7,791	e8,000	27,699	8,000
Sillimanite e 6		80	100	100	100	100	525
Spodumene, concentrate e		40,000	40,000	2 r40,736	2 r42,516	40,000	43,000
Stone, sand and gravel: e							
Construction sand 8	thousand tons	30,000	30,000	30,000	30,000	30,000	30,000
Gravel 8	do.	15,000	15,000	15,000	15,000	15,000	18,500
Dolomite	do.	1,000	1,000	1,000	10,000	10,000	10,000
Limestone:							
For cement	do.	6,000	6,000	6,000	6,000	6,000	7,250
For other uses	do.	6,000	6,000	6,000	6,000	6,000	6,000
Silica in the form of quartz, quartzite, glass sand	do.	2,000	2,000	2,000	2,000	2,000	2,375
Other: 8							
Crushed and broken stone	do.	65,000	65,000	65,000	65,000	65,000	70,300
Dimension stone	do.	100	100	100	100	100	170
Unspecified	do.	30,000	30,000	30,000	30,000	30,000	34,000
Sulfur: Byproduct:							
Metallurgy	do.	r213	r228	r223	r223	2228	507
Petroleum	do.	r70	r70	r70	r75	285	13
Total	do.	r283	r298	r293	r298	2313	520
Talc, chlorite, pyrophyllite, steatite e		200,000	205,000	216,000	215,000	215,000	216,000
MINERAL FUELS AND RELATED MATERIALS							
Coal:							
Bituminous and subbituminous	thousand tons	190,084	199,212	r206,045	r223,602	2223,898	224,000
Lignite	do.	48,252	47,725	r52,124	r50,228	249,243	53,000
Total	do.	238,336	246,937	r258,169	r273,830	2273,141	277,000
Coke, metallurgical	do.	4,073	4,527	e4,000	e4,000	4,500	4,550
Fuel briquets e	do.	750	750	750	750	750	825
Gas, natural, marketed	million cubic meters	17,806	20,726	21,687	r23,463	224,448	25,000
Natural gas liquids	thousand 42-gallon barrels	23,701	22,973	22,261	r23,411	222,989	26,000
Peat 8 e		11,000	11,000	11,000	11,000	11,000	16,000
Petroleum:							
Crude	thousand 42-gallon barrels	178,638	210,629	198,821	r195,31	2180,882	211,000
Refinery products:							
Gasoline:							
Aviation	do.	1,314	1,353	959	r1,076	21,013	XX
Motor	do.	101,109	103,401	106,576	r108,48	2112,267	XX
Jet fuel	do.	20,027	21,818	23,298	r24,728	227,134	XX
Kerosene	do.	358	846	315	r688	2289	XX
Distillate fuel oil	do.	64,615	67,523	68,857	r65,894	270,465	XX
Residual fuel oil	do.	15,102	15,673	17,374	r15,770	214,806	XX
Lubricants	do.	3,969	4,208	4,226	r4,384	24,258	XX

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
Refinery products—Continued:							
Liquefied petroleum gas	do.	5,101	4,851	5,646	r5,862	2,6,315	XX
Bitumen	do.	3,780	3,550	3,288	r3,561	2,4,296	XX
Unspecified	do.	6,328	5,558	6,760	r5,787	2,6,120	XX
Refinery fuel and losses	do.	5,132	2,314	5,763	r6,887	2,3,51	XX
Total	do.	226,835	231,095	243,062	r243,123	2,250,479	2,255,885

[e]Estimated. [r]Revised. XX Not applicable.
[1]Includes data available through Sept. 1, 1994.
[2]Reported figure.
[3]Data are for years ending Nov. 30 of that stated for plants owned by the Broken Hill Pty. Co. Ltd.
[4]Excludes tin content of copper-tin and tin-tungsten concentrates.
[5]Excludes production from Western Australia.
[6]In addition, about 7,000 tons of sillimanite clay, also known as kaolinized sillimanite, is produced, containing 40% to 48% aluminum oxide.
[7]Data are for fiscal years ending June 30 of that stated.
[8]Excludes data from some States.

TABLE 2

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities[1]	Annual capacity[e]
Alumina	Alcoa of Australia Ltd., 100%	Kwinana refinery, WA	1,700
Do.	do.	Pinjarra refinery, WA	3,000
Do.	do.	Wagerup refinery, WA	1,500
Do.	Nabalco Pty. Ltd., operator. (Swiss Aluminium Australia Ltd., 70%; and Gove Aluminium Ltd., 30%)	Gove refinery, NT	1,600
Do.	Queensland Alumina Ltd., operator. [Comalco Ltd., 30.3%; Kaiser Aluminum and Chemical Corp. (Australia) Ltd., 28.3%; Alcan Australia Ltd., 21.4%; and Pechiney Australia Pty. Ltd., 20%]	Gladstone refinery, QLD	3,225
Do.	Worsley Alumina Pty. Ltd., operator. [Reynolds Australia Alumina Ltd., 50%; The Shell Co. of Australia Ltd., 37.5%; Kobe Alumina Associates (Australia) Pty. Ltd., 10%; and Nissho Iwai Alumina, 2.5%]	Worsley refinery, WA	1,500
Aluminum	Alcan Australia Ltd., 100%	Kurri Kurri smelter, NSW	155
Do.	Alcoa of Australia Ltd., 100%	Point Henry smelter, VIC	180
Do.	Alcoa of Australia Ltd., 45% and manager; ALUVIC (State of Victoria agency), 25%; First National Resources Trust, 10%; China International Trust Investment Co., 10%; and Marubeni, 10%	Portland Island smelter, VIC	330
Do.	Boyne Island Smelters Ltd., operator. (Comalco Ltd., 30%; Australia Metallgesellschaft AG, 20%; Sumitomo Light Metal Industries, 17%; Kobe Steel Ltd., 9.5%; Mitsubishi Corp., 9.5%; Yoshida Kogyo KK, 9.5%; and Sumitomo Aluminium Smelting Co. Ltd., 4.5%)	Boyne Island smelter, QLD	230
Do.	Comalco Aluminium (Bell Bay) Ltd., 100%	Bell Bay smelter, TAS	155
Do.	Tomago Aluminium Co. Pty. Ltd., operator. (Gove Aluminium Finance Ltd., 35%; Pechiney Australia Pty. Ltd., 35%; Australian Mutual Provident Society, 15%; VAW Australia Pty. Ltd., 12%; and Hunter Douglas Ltd., 3%)	Tomago smelter, NSW	380

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities[1]	Annual capacity[e]
Bauxite	Alcoa of Australia Ltd., 100%	Huntly, Jarrahdale, and Willowdale Mines, WA	22,100
Do.	Comalco Aluminium Ltd., 100%	Weipa operations, QLD	11,000
Do.	Nabalco Pty. Ltd., operator. (Swiss Aluminium Australia Ltd., 70%; and Gove Aluminium Ltd., 30%)	Gove Mine, NT	6,700
Do.	Worsley Alumina Pty. Ltd., operator. [Reynolds Australia Alumina Ltd., 50%; The Shell Co. of Australia Ltd., 37.5%; Kobe Alumina Associates (Australia) Pty. Ltd., 10%; and Nissho Iwai Alumina, 2.5%]	Mount Saddleback (Worsley) Mine, WA	3,850
Cement	Adelaide Brighton Cement Ltd., 100%	Birkenhead Plant, SA	1,000
Do.	do.	Geelong Plant, VIC	800
Do.	Blue Circle Southern Cement Ltd., 100%	Berrima Plant, NSW	1,200
Do.	Cockburn Cement Ltd., 100%	South Coogee Plant, WA	1,000
Do.	Goliath Cement Holdings Ltd., 100%	Railton Plant, TAS	1,000
Do.	Queensland Cement Ltd., 100%	Darra Plant, QLD	700
Coal, black	Arco Coal Australia Inc., 80% and manager; Mitsui and Co. Ltd., 15%; and Lend Lease Resources Pty. Ltd., 5%	Gordonstone underground mine, QLD	4,200
Do.	BHP Steel Collieries Division, 100%	Appin underground mine, NSW	2,400
Do.	do.	Cordeaux underground mine, NSW	2,800
Do.	do.	Tower underground mine, NSW	1,400
Do.	Camberwell Coal Pty. Ltd., operator. (Navidale Pty. Ltd., 50%; Toyota Tsusho Corp., 40%; and Dia Coal Ltd., 10%)	Camberwell open cut, NSW	2,400
Do.	Capricorn Coal Management Pty. Ltd., manager. (The Shell Co. of Australia Ltd., 46.75%; Minproc Energy Pty. Ltd., 26.06%; British Coal Corp., 14.81%; and Ruhrkohle Australia Pty. Ltd., 12.38%)	German Creek open cut and underground mine, QLD	6,000
Do.	Central Queensland Coal Associates, 100%. (BHP Australia Coal Ltd., 44.72% and operator; QCT Resources, 27.78%; Mitsubishi Development Pty. Ltd., 13.33%; AMP Society, 8.61%; and Pancontinental Mining Ltd., 5.56%)	Blackwater open cut, QLD	5,000
Do.	do.	Goonyella-Riverside open cuts, QLD	9,250
Do.	do.	Norwich Park open cut, QLD	4,500
Do.	do.	Peak Downs open cut, QLD	5,500
Do.	do.	Saraji open cut, QLD	4,700
Do.	Coal and Allied Industries Ltd., 100%	Hunter Valley No. 1 and No. 2 open cuts, NSW	7,500
Do.	Coal and Allied Industries Ltd., 80% and manager; and Pahong Iron and Steel Co. Ltd., 20%	Mount Thorley open cut, NSW	6,500
Do.	Clutha Ltd., 100%	Brimstone No. 1 underground mine, NSW	2,400
Do.	Curragh Queensland Mining Ltd., operator. [ARCO Coal Australia Inc., 60%; R.W. Miller Ltd., 30%; and Mitsui Coal Development (Australia) Ltd., 10%]	Curragh open cut, QLD	6,600
Do.	ENC (Management) Pty. Ltd., manager. Newcom Collieries Pty. Ltd., 100%	Angus Place underground mine, NSW	1,300
Do.	do.	Cooranbong underground mine, NSW	1,200
Do.	do.	Myuna underground mine, NSW	1,500

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities[1]	Annual capacity[e]
Coal, black—Continued:			
Do.	ENC Management Pty. Ltd., manager. Elcom Colleries Pty. Ltd., 100%	Awaba State underground mine, NSW	1,000
Do.	do.	Munmorah State underground mine, NSW	1,200
Do.	do.	Newstan State underground mine, NSW	2,200
Do.	do.	Wyee State underground mine, NSW	1,750
Do.	Electricity Trust of South Australia, 100%	Leigh Creek open cut mine, SA	3,000
Do.	FAI Mining Ltd., 70% and manager; Marubeni Coal Pty. Ltd., 14%; Taiheiyo Australia Pty. Ltd., 10%; Chelsea Coal Pty. Ltd., 3%; and Kokan Kogyo (Australia) Pty. Ltd., 3%	Teralba underground mine, NSW	1,700
Do.	do.	West Wallsend underground mine, NSW	2,400
Do.	Kembla Coal and Coke Pty. Ltd., 100%	Tahmoor underground mine, NSW	4,100
Do.	do.	West Cliff underground mine, NSW	3,000
Do.	MIM Holdings Ltd., 75%; and Agipcoal Australia Pty. Ltd., 25%	Newlands open cut, QLD	4,000
Do.	Oakbridge Ltd., 100%	Gretley underground mine, NSW	1,300
Do.	do.	Ellalong underground mine, NSW	2,000
Do.	Oakbridge Ltd., 80% and manager; and Sumitomo Coal Mining Co. Ltd., 20%	Baal Bone underground mine, NSW	2,500
Do.	Oakbridge Ltd., 80%, manager; and Kyodo Oil of Japan, 10%; and Yukong Oil Ltd. (Republic of Korea), 10%	Clarence underground mine, NSW	1,900
Do.	Pacific Coal Pty. Ltd., 57.19%, operator; ARCO Coal Australia Inc., 31.42%; Electric Power Development Co., 7.97%; and Joint Coal Development Co. Ltd., 3.42%	Blair Athol open cut, QLD	8,500
Do.	Shell Australia Ltd., 100%	South Bulli underground mine, NSW	3,000
Do.	Ulan Coal Mines Ltd., manager. (Mitsubishi Development Pty. Ltd., 49%; Exxon Coal Authorities Australia Ltd., 36%; and the State Superannuation Board of NSW, 15%)	Ulan No. 2 underground and Ulan open cut mines, NSW	5,500
Do.	Wambo Mining Corp. Pty. Ltd., 100%	Wambo underground and open cut mines, NSW	4,000
Coal, brown	State Electricity Commission of Victoria, 100%	Latrobe Valley open cut mines (Loy Yang, Morwell, and Yallourn, VIC	48,000
Copper	Aberfoyle Ltd., 100%	Hellyer Mine, TAS	4
Do.	Australian Resources and Mining Co. NL, 100% (formerly Arimco NL)	Selwyn (Starra) Mine, QLD	16
Do.	Copper Refineries Pty. Ltd., operator. (MIM Holdings Ltd., 100%)	Townsville Refinery, QLD	175
Do.	Denehurst Ltd., 100%	Woodlawn Mine, NSW	8
Do.	Denehurst Ltd., 50% and manager; and Macquarie Resources Ltd., 50%	Benambra Mine, VIC	18
Do.	GSM Metals Pty. Ltd., operator. (Golden Shamrock Mines Ltd., 70%; and private interests, 30%)	Cobar (CSA) Mine, NSW	35
Do.	Gunpowder Copper Ltd., operator. (Adelaide Brighton Cement Holdings Ltd., 100%)	Gunpowder Mine, QLD	9

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities[1]	Annual capacity[e]
Copper—Continued:			
Do.	Horseshoe Gold Mine Project, manager. (Sabminco NL, 57%; and Asian Pacific Resources Pty. Ltd., 43%)	Horseshoe Mine, WA	15
Do.	Mount Isa Mines Ltd., operator. (MIM Holdings Ltd., 100%)	Hilton Mine at Mount Isa, QLD	180
Do.	do.	Mount Isa Smelter, QLD	175
Do.	Murchison Zinc Co. Pty. Ltd., operator. (Normandy Poseidon Ltd., 45%; Esso Australia Resources Ltd., 35%; and Aztec Mining Co. Ltd., 20%)	Golden Grove Project (includes Gossan Hill and Scuddles Mines), WA	4
Do.	Newcrest Mining Ltd., 100%	Telfer Mine, WA	2
Do.	Nord Pacific Ltd., operator. [Straits Engineers Pte. Ltd. (Singapore), 60%; and Nord Pacific Ltd., 40%]	Giralambone Mine, NSW	15
Do.	Olympic Dam Corp. Pty. Ltd., manager. (Western Mining Corp. Holdings Ltd., 100%)	Oympic Dam Mine, SA	66
Do.	do.	Oympic Dam Refinery, SA	50
Do.	do.	Oympic Dam Smelter, SA	70
Do.	Pancontinental Mining Ltd., manager, 50%; Outokumpu Australia Pty. Ltd., 25%; and Agip Australia Pty. Ltd., 25%	Thalanga Mine, QLD	9
Do.	Pasminco Ltd., 100%	Rosebery Mine, TAS	4
Do.	Peak Gold Mines Pty. Ltd., operator. (CRA Ltd., 100%)	Peak Mine, NSW	3
Do.	Poseidon Gold Ltd., 100%	Gecko Mine, NT	17
Do.	Red Dome Pty. Ltd., operator. (Niugini Mining Ltd., 100%)	Red Dome Mine, QLD	6
Do.	Renison Goldfields Consolidated Ltd., 100%	Mount Lyell Mine, TAS	25
Do.	Southern Copper Ltd., manager. (Enterprise Metals Ltd., 60%; Corp., 10%) Furukawa Co. Ltd., 30%; and Nissho-Iwai Corp., 10%)	Port Kembla Refinery, NSW	80
Do.	do.	Port Kembla Smelter, NSW	80
Do.	do.	Port Kembla Smelter, NSW	80
Do.	Western Mining Corp. Holdings Ltd., 100%	Nifty Mine, WA	16
Do.	Worsley Alumina Pty. Ltd., operator. [Reynolds Australia Metals Ltd., 40%; Billiton Australia Gold Pty. Ltd., 30%; Newcrest Mining Ltd., 20%; and Kobe Alumina Associates (Australia) Pty. Ltd., 10%]	Boddington Mine, WA	10
Diamond	Argyle Diamond Mines Pty. Ltd., manager. (CRA Ltd., 59.7%; and Ashton Mining Ltd., 40.3%)	Argyle Mine (AK-1 pipe and alluvial deposits), WA	[2]35,000
Do.	Poseidon Bow River Diamond Mine Ltd., 100%.	Bow River Mine, WA	[2]1,000
Gas, natural and gas condensate	Woodside Petroleum Pty. Ltd., manager; BP Developments Australia Ltd.; Chevron Asiatic Oil Co.; Shell Development (Australia) Pty. Ltd.; BHP Petroleum (North West Shelf) Pty. Ltd.; and Japan Australia Oil (MiMi) Pty. Ltd., 16.67% each	North West Shelf Gas Project, 140 km offshore of Dampier, WA	[3]20 [4]60
Gold	Alcoa of Australia Ltd., 100%	Hedges Mine, WA	[5]4,900
Do.	Asarco Australia Ltd., 100%	Wiluna Mine, WA	[5]4,225
Do.	Australian Gold Refineries, 100% (State of Western Australia agency)	Kalgoorie refinery, WA	[5]46,000
Do.	do.	Perth refinery (Newburn), WA	[5]95,000
Do.	Australian Resources and Mining Co. NL, 100% (formerly Arimco NL)	Selwyn (Starra) Mine, QLD	[5]3,600
Do.	Aztec Mining Co. Ltd., operator, 62%; and Forrestania Gold NL, 38%	Bounty Mine, WA	[5]2,500
Do.	Carpentaria Gold Pty. Ltd., 100%	Tick Hill Mine, QLD	[5]5,500

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities[1]	Annual capacity[e]
Gold—Continued:			
Do.	Dominion Mining Ltd., 100%	Cosmo Howley Mine, NT	[5]1,700
Do.	do.	Meekatharra area mines, WA	[5]2,300
Do.	Golden Valley Joint Venture, manager. (Placer Pacific Ltd., 60%; and Delta Gold NL, 40%)	Granny Smith Mine, WA	[5]4,800
Do.	Hampton Australia Ltd., operator. (Gold Mines of Kalgoorlie Ltd., 100%)	Jubilee Mine, WA	[5]2,300
Do.	Hill 50 Gold Mine NL, operator. (Western Mining Corp. Holdings Ltd., 100%)	Mount Magnet Mine, WA	[5]5,000
Do.	Homestake Gold of Australia, 100%	Fortnum Mine, WA	[5]1,500
Do.	Kalgoorlie Consolidated Gold Mines Pty. Ltd., manager. (Gold Mines of Kalgoorlie Ltd., 50%; and Homestake Gold of Australia Ltd., 50%)	Kalgoorlie Super Pit (Fimiston), WA	[5]16,000
Do.	do.	Mount Charlotte Mine, WA	[5]4,300
Do.	Kidston Gold Mines Ltd., 100%	Kidston Mine, QLD	[5]6,000
Do.	MIM Holdings Ltd., 100%	Pacific precious metals refinery, NSW	[5]1,900
Do.	Mining Corp. of Australia Ltd., 100%	Mount Pleasant Mine, WA	[5]1,750
Do.	Mount Leyshon Gold Mines Ltd., 100%	Mount Leyshon Mine, QLD	[5]7,000
Do.	Newcrest Mining Ltd., 100%	Ora Banada Mine, WA	[5]2,650
Do.	do.	Telfer Mine, WA	[5]12,000
Do.	do.	Tuckabianna Mine, WA	[5]1,700
Do.	Newcrest Mining Ltd., manager, 80%; and HTA Pty. Ltd., 20%	New Celebration Mine, WA	[5]4,750
Do.	North Flinders Mines Ltd., 100%	The Granites Mine, NT	[5]4,750
Do.	Olympic Dam Corp. Pty. Ltd., manager. (Western Mining Corp. Holdings Ltd., 100%)	Oympic Dam Mine, SA	[5]1,500
Do.	Pajingo Gold Mine Pty. Ltd., 100%	Pajingo Mine, QLD	[5]1,900
Do.	Paragon Resources NL, 100%	Temora Mine, NSW	[5]2,250
Do.	Peak Gold Mines Pty. Ltd., operator. (CRA Ltd., 100%)	Peak Mine, NSW	[5]3,100
Do.	Peko Gold Ltd., manager, 50%; and Delta Gold NL, 50%	Kanowna Belle Mine, WA	[5]5,600
Do.	Plutonic Resources Ltd., 100%	Plutonic Mine, WA	[5]5,000
Do.	Poseidon Gold Ltd., 100%	Big Bell Mine, WA	[5]5,500
Do.	do.	Golden Crown Mine, WA	[5]1,150
Do.	Red Dome Pty. Ltd., operator. (Niugini Mining Ltd., 100%)	Red Dome Mine, QLD	[5]2,000
Do.	Renison Goldfields Consolidated Ltd., 100%	Pine Creek Mine, NT	[5]3,100
Do.	Reynolds Australia Metals Ltd., 100%	Gibson Mine, WA	[5]3,450
Do.	Ross Mining NL, 100%	Wirralie Mine, QLD	[5]3,200
Do.	Sons of Gwalia Ltd., 100%	Leonora Mine, WA	[5]2,800
Do.	Stawell Gold Mines Joint Venture, manager. (MPI Gold Gold Pty. Ltd., 50%; and Pittston Mineral Ventures of Australia, 50%)	Stawell Mine, VIC	[5]1,100
Do.	Western Mining Corp. Holdings Ltd., 100%	Kambalda-St. Ives Mines, WA	[5]7,500
Do.	Worsley Alumina Pty. Ltd., operator. [Reynolds Australia Metals Ltd., 40%; Billiton Australia Gold Pty. Ltd., 30%; Newcrest Mining Ltd., 20%; and Kobe Alumina Associates (Australia) Pty. Ltd., 10%]	Boddington Mine, WA	[5]11,000
Do.	Zapopan NL, 100%	Mount Todd Mine, NT	[5]3,100
Do.	do.	Tanami Mine, NT	[5]1,900

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities[1]	Annual capacity[e]
Iron ore	BHP Iron Ore Ltd., 85%; CI Minerals Australia Pty. Ltd., 8%; and Mitsui Iron Ore Corp. Pty. Ltd., 7%	Yandi Mine, WA	6,500
Do.	Channar Management Services, manager. [Hamersley Iron Pty. Ltd., 60%; and CMIEC (Channar) Pty. Ltd., 40%, a People's Republic of China Government Agency]	Channar Mine, WA	5,500
Do.	Hamersley Iron Pty. Ltd., 100%	Mount Tom Price Mine, WA	28,000
Do.	do.	Paraburdoo Mine, WA	15,000
Do.	do.	Brockman No. 2 Mine, WA	4,500
Do.	BHP Iron Ore Ltd., 55% and manager; BHP Australia Coal Pty. Ltd., 30%; CI Minerals Australia Pty. Ltd., 8%; and Mitsui-C. Itoh Iron Corp. Ltd., 7%	Nimingarra-Sunrise Hill and Yarrie Mines (Mount Goldsworthy extension project, WA)	6,500
Do.	BHP Iron Ore Ltd., 55% and manager; Pilbarra Iron Ltd., 30%; Mitsui-C. Itoh Pty. Ltd., 10%; and CI Minerals Australia Pty. Ltd., 5%	Mount Whaleback Mine, WA	35,000
Do.	Robe River Iron Associates, manager. (North Broken Hill-Peko Ltd., 35%; Robe River Mining Co. Pty. Ltd., 30%; Mitsui Iron Ore Development Pty. Ltd., 20%; Pannawonica Iron Associates, 10%; and Cape Lambert Iron Associates, 5%)	Pannawonica-Deepdale (Robe River) Mine, WA	27,000
Do.	Savage River Mines, operator. (Pickands Mather and Co. International, 100%)	Savage River Mine, TAS	1,500
Lead	Aberfoyle Ltd., 100%	Hellyer Mine, TAS	45
Do.	Aztec Mining Co. Ltd., 100%	Woodcutters Mine, NT	10
Do.	BHP Minerals Ltd., 58% and manager; Billiton Australia Ltd., 42%	Cadjebut Mine, WA	16
Do.	Denehurst Ltd., 100%	Woodlawn Mine, NSW	14
Do.	GSM Metals Pty. Ltd., operator. (Golden Shamrock Mines Ltd., 100%)	Cobar (CSA) Mine, NSW	4
Do.	Mount Isa Mines Ltd., operator. (MIM Holdings Ltd., 100%)	Mount Isa Mine, QLD	190
Do.	Pancontinental Mining Ltd., manager, 50%; Outokumpu Australia Pty. Ltd., 25%; and Agip Australia Pty. Ltd., 25%	Thalanga Mine, QLD	15
Do.	Pasminco Ltd., 100%	Broken Hill (South) Mine, NSW	150
Do.	do.	Elura Mine, NSW	15
Do.	do.	Rosebery Mine, TAS	15
Do.	Peak Gold Mines Pty. Ltd., manager. (CRA Ltd., 100%)	Peak Mine, NSW	4
Do.	McArthur River Mining Pty. Ltd., operator. (MIM Holdings Ltd., 70%; and ANT Minerals Pty. Ltd. holding the combined Japanese interests of Nippon Mining Co., 15%; Mitsubishi Corp., 5%; Mitsui & Co., 5%; and Marubeni Corp., 5%)	McArthur River Mine, NT	45
Do.	Mount Isa Mines Ltd., operator. (MIM Holdings Ltd., 100%)	Mount Isa smelter, QLD	240
Do.	Pasminco Ltd., 100%	Cockle Creek smelter, NSW	30
Do.	do.	Port Pirie refinery-smelter, SA	220
Lithium	Gwalia Consolidated. Ltd., 100%	Greenbushes Mine, WA	[6]84
Manganese	Groote Eylandt Mining Co. Pty. Ltd., operator. (BHP Minerals Ltd., 100%)	Groote Eylandt Mine, NT	2,300
Do.	Portman Mining Ltd., 50% and manager; and Gayna Park Pty. Ltd., 50%	Woodie Woodie Mine, WA	400
Manganese alloys	Tasmanian Electro Metallurgical Co. Pty. Ltd., 100%	Bell Bay smelter, TAS	260

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities[1]	Annual capacity[e]
Mineral sands	Cable Sands (WA) Pty. Ltd., operator. [Nissho Iwai Corp. (Japan), 100%]	Busselton East and Waroona Mines, WA	[7]100
Do.	Consolidated Rutile Ltd., 100%	North Stradbroke Island (Bayside and Gordon) Mines, QLD	[8]850 [9]65
Do.	Mineral Deposits Ltd., operator. (BHP Minerals Ltd., 100%)	Hawks Nest (Stockton, Viney Creek, and Viney Creek North) Mines, NSW	[7]10 [8]35 [9]25
Do.	Minproc Chemical Co. Pty. Ltd., 50% and manager; and	Cooljarloo Mine, WA	[7]480
Do.	Kerr-McGee Chemical Corp., 50% (Tiwest Joint Venture)		[8]35 [9]67 [10]10
Do.	RGC Mineral Sands Ltd., manager. (Renison Goldfields Consolidated Ltd., 100%)	Capel Mine, WA	[7]180 [8]40 [9]68 [10]3
Do.	do.	Eneabba North, South, and West Mines, WA	[7]600 [8]120 [9]300
Do.	RZM Pty. Ltd., operator. [Nissho Iwai Corp. (Japan), 100%]	Tomago Mines, NSW	[8]35 [9]30
Do.	Westralian Sands Pty. Ltd., 100%	Yoganup North Mine, WA	[7]300 [8]115 [9]30 [10]5
Nickel	Dominion Mining Ltd., 100%	Yakabindie Mine,12/ WA	21
Do.	Outokumpu Australia Pty. Ltd. and Outokumpu Western Australia Pty. Ltd., 50% each and both wholly owned subsidiaries of Outokumpu Oy of Finland	Forrestania area mines, 375 km southeast of Perth, WA	8
Do.	Queensland Nickel Joint Venture, manager. [QNI Ltd., 80%; and Nickel Resources North Queensland Pty. Ltd. (State of Queensland agency), 20%]	Yabulu refinery, QLD	30
Do.	Western Mining Corp. Holdings Ltd., 100%	Kalgoorlie smelter, WA	57
Do.	do.	Kambalda Nickel Operations (KNO), WA	35
Do.	do.	Kwinana refinery, WA	42
Do.	do.	Leinster Nickel Operations (LNO), WA	30
Do.	do.	Mount Keith Mine, WA	28
Opal	Many small producers	Andamooka and Coober Pedy areas, SA; Lightning Ridge area, NSW	NA
Petroleum	Ampol Refineries Ltd., 100%	Lytton refinery, QLD	[13]74
Do.	BP Refinery (Bulwer Island) Pty. Ltd., 100%	Bulwer Island refinery, QLD	[13]53
Do.	BP Refinery (Kwinana) Pty. Ltd., 100%	Kwinana refinery, WA	[13]120
Do.	Caltex Refining Co. Pty. Ltd., 100%	Kurnell refinery, NSW	[13]108
Do.	Petroleum Refineries (Australia) Pty. Ltd., manager. (Mobil Oil Australia Ltd., 100%)	Altona refinery, VIC	[13]108
Do.	do.	Port Stanvac refinery, SA	[13]72
Do.	Shell Refining (Australia) Pty. Ltd., 100%	Clyde refinery, NSW	[13]91
Do.	do.	Geelong refinery, NSW	[13]132

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities[1]	Annual capacity[e]
Salt	Dampier Salt (Operations) Pty. Ltd., 100%	Dampier and Lake McCleod salt fields, WA	4,500
Do.	Leslie Salt Division, Cargill Australia Ltd., 100%	Leslie Salt operations, WA	2,750
Steel	BHP Steel Ltd., 100%	Newcastle steelworks, NSW	1,800
Do.	do.	Port Kembla steelworks, NSW	4,000
Do.	do.	Whyalla steelworks, SA	1,200
Do.	BHP Steel Ltd., 100%	Sydney (Rooty Hill) minimill, NSW	250
Talc	Three Springs Talc Pty. Ltd., 100%	Three Springs Mines, WA	200
Tin	Gwalia Consolidated Ltd., 100%	Greenbushes Mine, WA	1
Do.	do.	Greenbushes smelter, WA	1
Do.	Renison Goldfields Consolidated Ltd., 100%	Renison Bell Mine, TAS	6
Do.	Spectrum Resources Australia Pty. Ltd., 98% and manager; and Nargun Pty. Ltd., 2%	Anchor (Blue Tier) Mine, TAS	3
Uranium	Energy Resources of Australia Ltd., 100%	Ranger Mine, NT	[14]4,500
Do.	Olympic Dam Corp. Pty. Ltd., manager. (Western Mining Corp. Holdings Ltd., 100%)	Oympic Dam Mine, SA	[14]1,500
Zinc	Aberfoyle Ltd., 100%	Hellyer Mine, TAS	115
Do.	Aztec Mining Co. Ltd., 100%	Woodcutters Mine, NT	45
Do.	BHP Minerals Ltd., 58% and manager; and Billiton Australia Ltd., 42%	Cadjebut Mine, WA	65
Do.	Denehurst Ltd., 100%	Woodlawn Mine, NSW	55
Do.	McArthur River Mining Pty. Ltd., operator. (MIM Holdings Ltd., 70%; and ANT Minerals Pty. Ltd. holding the combined Japanese interests of Nippon Mining Co., 15%; Mitsubishi Corp., 5%; Mitsui & Co., 5%; and Marubeni Corp., 5%)	McArthur River Mine, NT	160
Do.	Mount Isa Mines Ltd., manager. (MIM Holdings Ltd., 100%)	Mount Isa Mine, QLD	250
Do.	Murchison Zinc Co. Pty. Ltd., manager. (Normandy Poseidon Ltd., 45%; Esso Australia Resources Ltd., 35%; and Aztec Mining Co. Ltd., 20%)	Golden Grove Project (includes Gossan Hill and Scuddles Mines), WA	95
Do.	Pancontinental Mining Ltd., manager, 50%; Outokumpu Australia Pty. Ltd., 25%; and Agip Australia Pty. Ltd., 25%	Thalanga Mine, QLD	45
Do.	Pasminco Ltd., 100%	Beltana Mine, SA	30
Do.	do.	Broken Hill (South) Mine, NSW	210
Do.	do.	Cockle Creek refinery-smelter,	85
Do.	do.	Elura Mine, NSW	30
Do.	do.	Port Pirie refinery-smelter, SA	45
Do.	Pasminco Ltd., 100%	Ridson refinery, TAS	220
Do.	do.	Rosebery Mine, TAS	45

[e]Estimated. NA Not available.

[1]NSW, New South Wales; NT, Northern Territory; QLD, Queensland; SA, South Australia; TAS, Tasmania; VIC, Victoria; WA, Western Australia.

[2]Thousand carats.

[3]20 million cubic meters per day natural gas.

[4]Thousand 42-gallon barrels per day gas condensate.

[5]Kilograms gold.

[6]Thousand tons spodumene.

[7]Thousand tons ilmenite.

[8]Thousand tons rutile.

[9]Thousand tons zircon.

[10]Thousand tons leucoxene.

[11]Thousand tons monazite.

[12]Scheduled to commence development in 1995.

[13]Thousand 42-gallon barrels per day crude petroleum.

[14]Tons triuranium octoxide.

TABLE 3
AUSTRALIA: LARGEST GOLD MINES IN 1993

Mine and State or Territory	1993 production (kilograms)
1. Kalgoorlie Super Pit, Western Australia	16,423
2. Telfer, Western Australia	11,726
3. Boddington, Western Australia	11,571
4. Kambalda-St. Ives, Western Australia	8,398
5. Mount Leyshon, Queensland	7,060
6. Kidston, Queensland	6,967
7. The Granites, Northern Territory	5,941
8. Plutonic, Western Australia	5,568
9. Mount Magnet, Western Australia	5,443
10. Tick Hill, Queensland	5,443
11. Granny Smith, Western Australia	5,319
12. New Celebration, Western Australia	5,194
13. Mount Charlotte, Western Australia	4,386
14. Bounty, Western Australia	4,199
15. Kanowna Belle, Western Australia	1,680

Source: J. B. Were and Son.

TABLE 4

AUSTRALIA: RESERVES OF MAJOR MINERAL COMMODITIES

(Thousand metric tons unless otherwise specified)

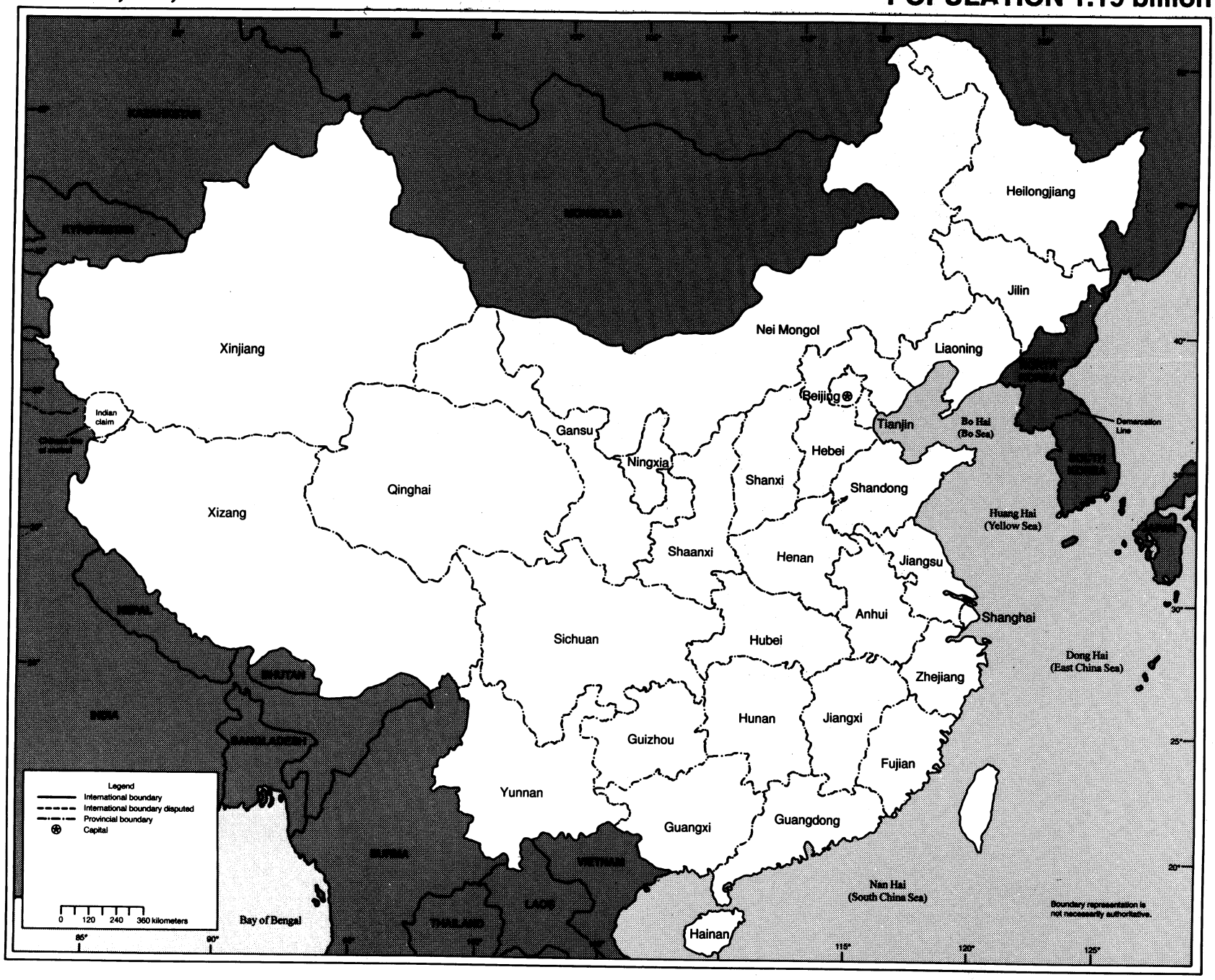
Commodity		Reserves
Antimony		116.5
Bauxite	million metric tons	2,582.0
Black coal:		
In situ	billion metric tons	69.0
Recoverable	do.	52.0
Brown coal:		
In situ	do.	46.0
Recoverable	do.	41.0
Cadmium		84.7
Cobalt		52.0
Columbium		3.4
Copper	million metric tons	20.2
Diamond:		
Gem and near gem	million carats	147.0
Industrial	do.	189.0
Gold	metric tons	3,003.0
Iron ore	billion metric tons	17.9
Lead	million metric tons	19.4
Lithium		160.0
Magnesite ($MgCO_3$)	million metric tons	218.7
Manganese ore	do.	107.0
Mineral sands:		
Ilmenite	do.	116.1
Rutile	do.	14.0
Zircon	do.	20.9
Nickel	do.	2.9
Petroluem, recoverable:		
Condensate	billion liters	124.0
Crude	do.	258.0
Liquefied petroleum gas	do.	131.0
Natural gas	billion cubic meters	950.0
Platinum-group metals (Pd, Pt)	metric tons	17.7
Rare earths (REO plus Y_2O_3)		1,000.0
Silver		33.6
Tantalum		6.3
Tin		123.3
Tungsten		1.1
Uranium, recoverable		631.0
Vanadium		19.0
Zinc	million metric tons	37.6

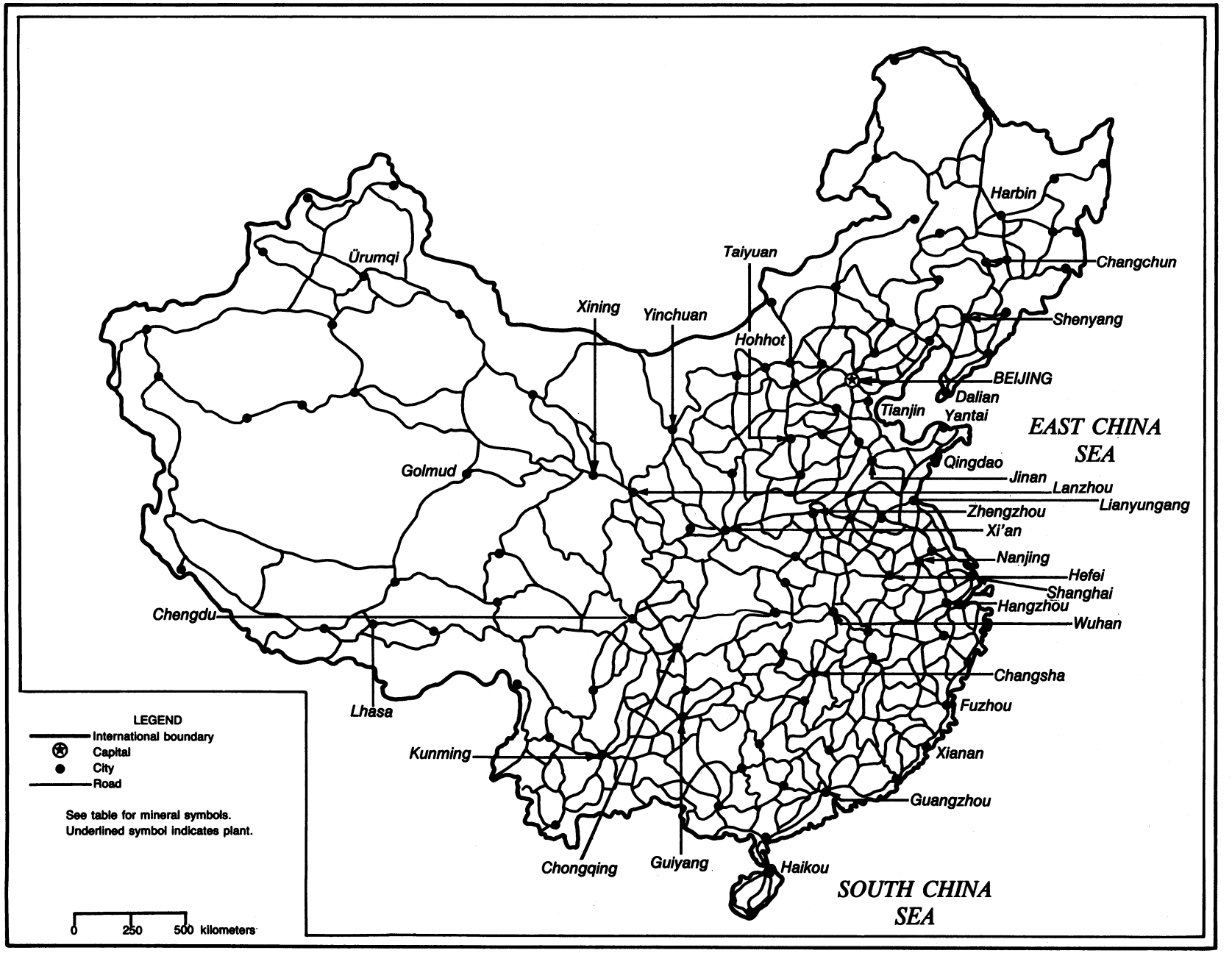
Source: Mineral Resources Branch, Bureau of Resource Sciences, Canberra, Australia.

CHINA

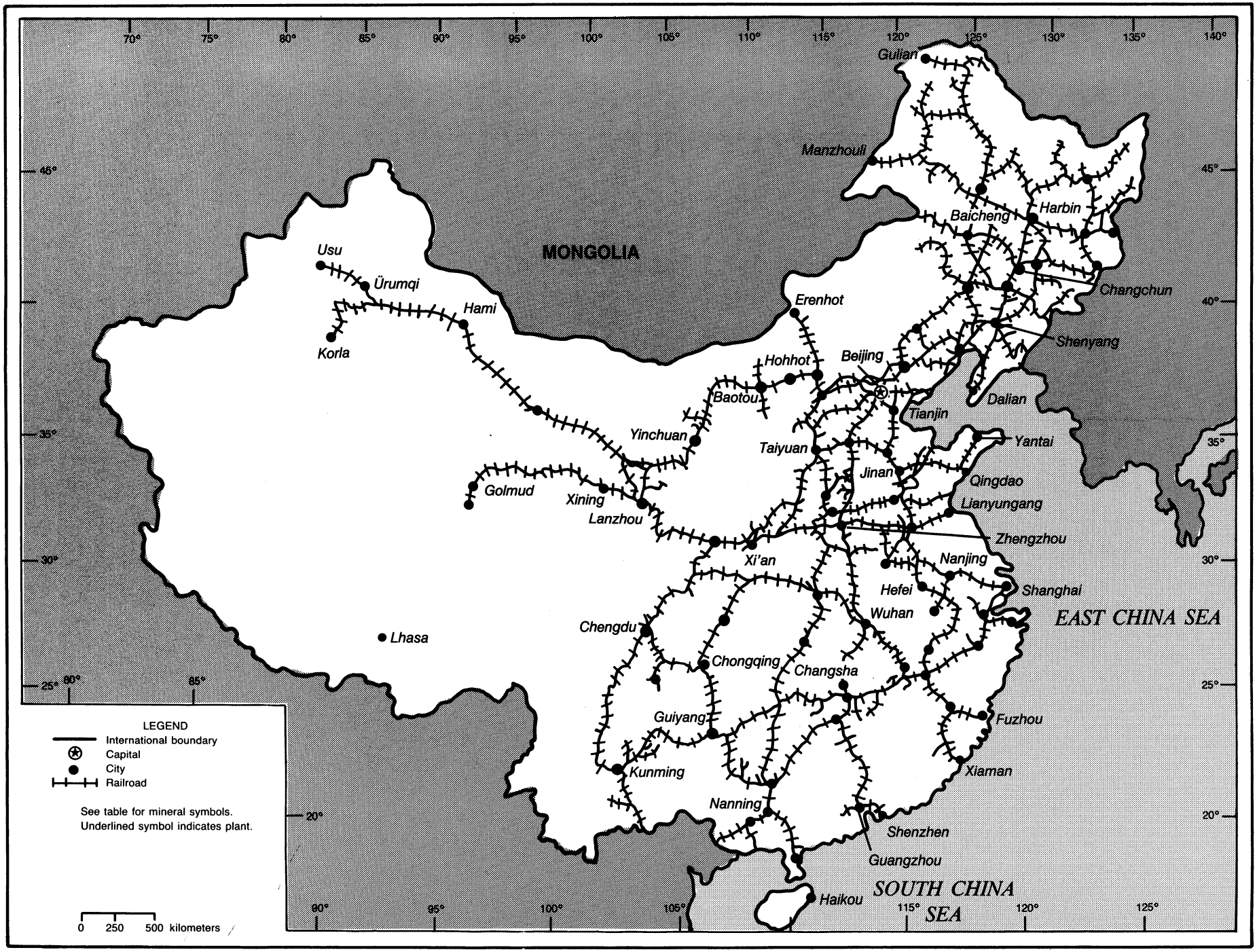
AREA 9,596,960 km²

POPULATION 1.19 billion

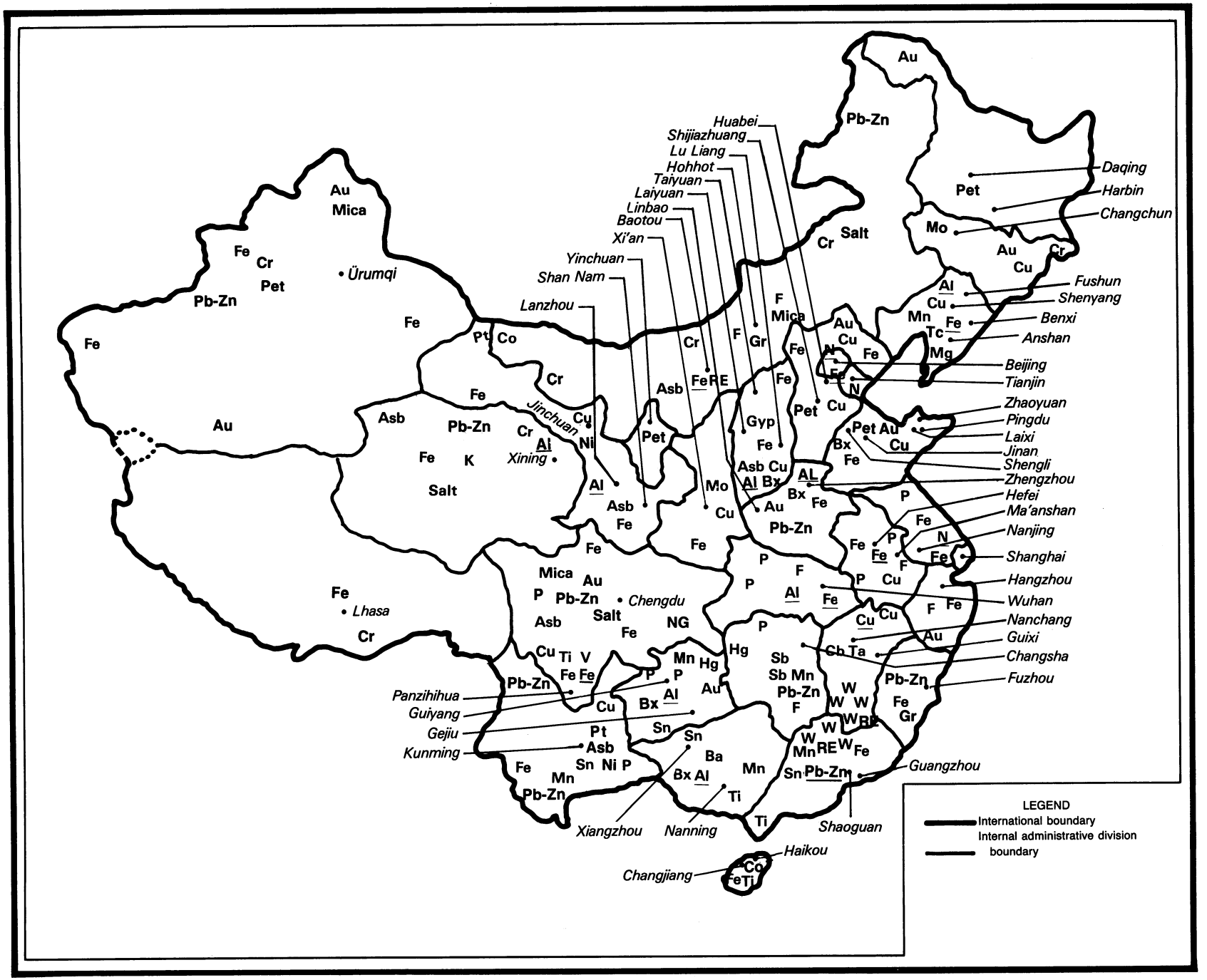




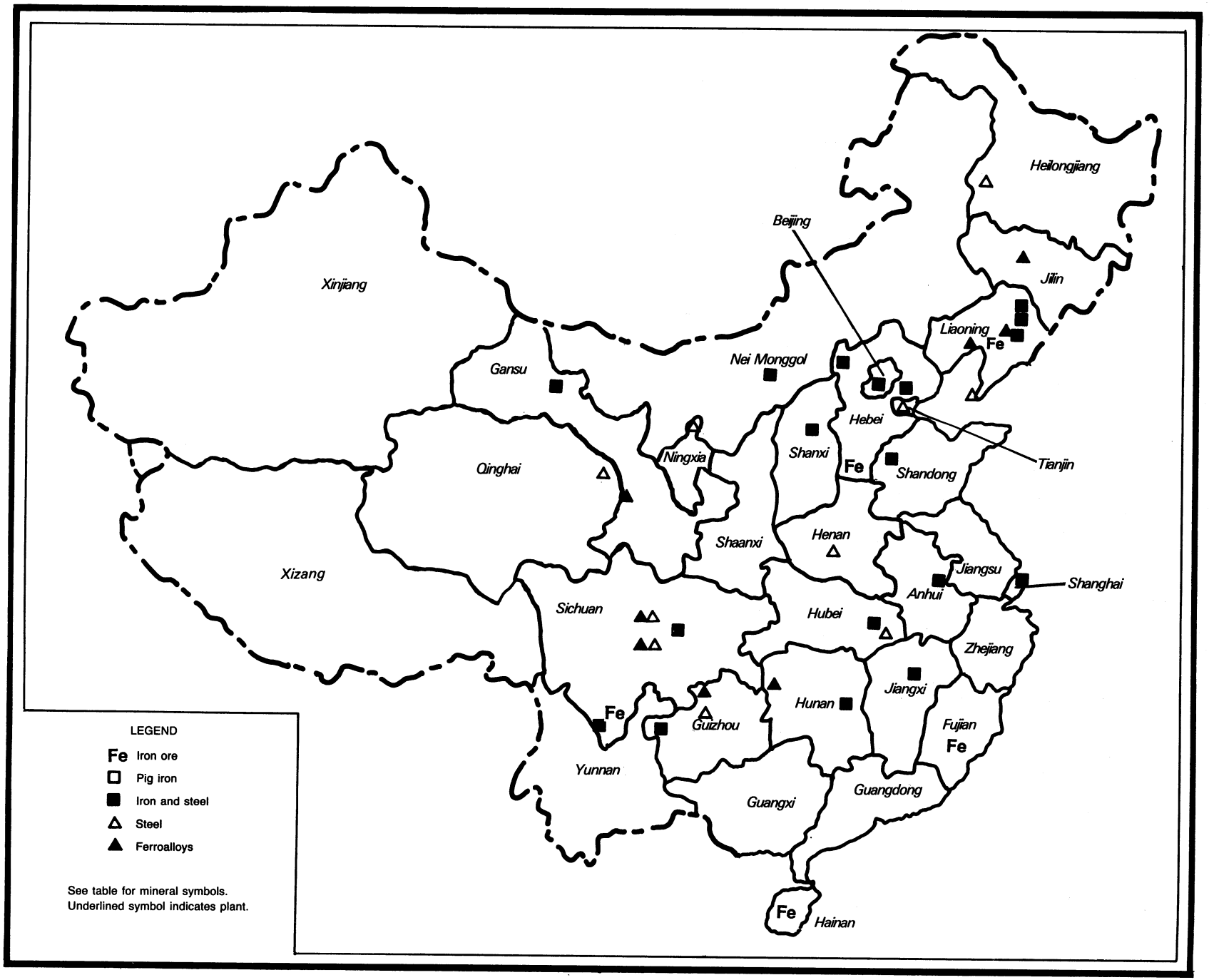
PRINCIPAL ROADS IN CHINA



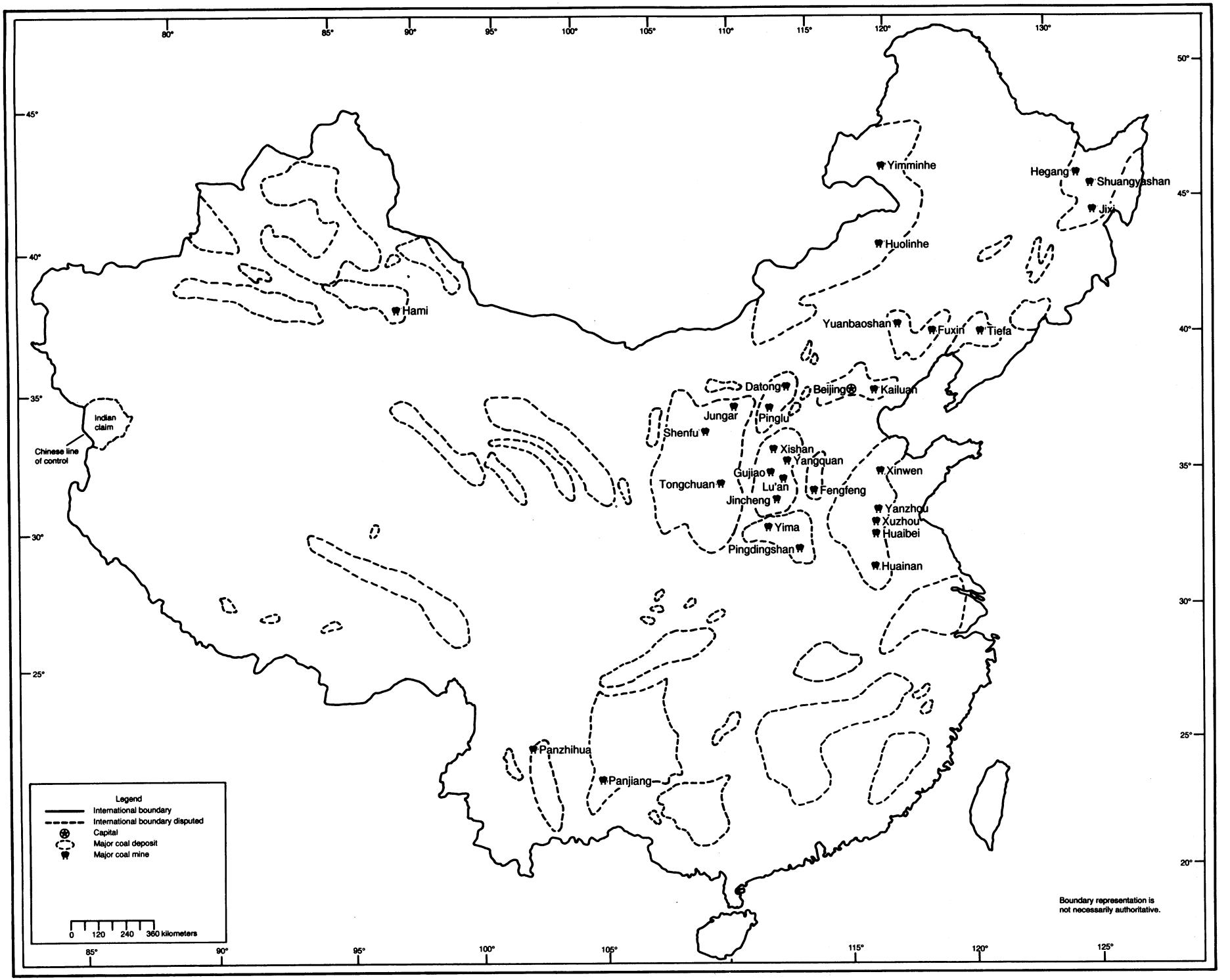
PRINCIPAL RAILWAYS IN CHINA



MINERALS IN CHINA

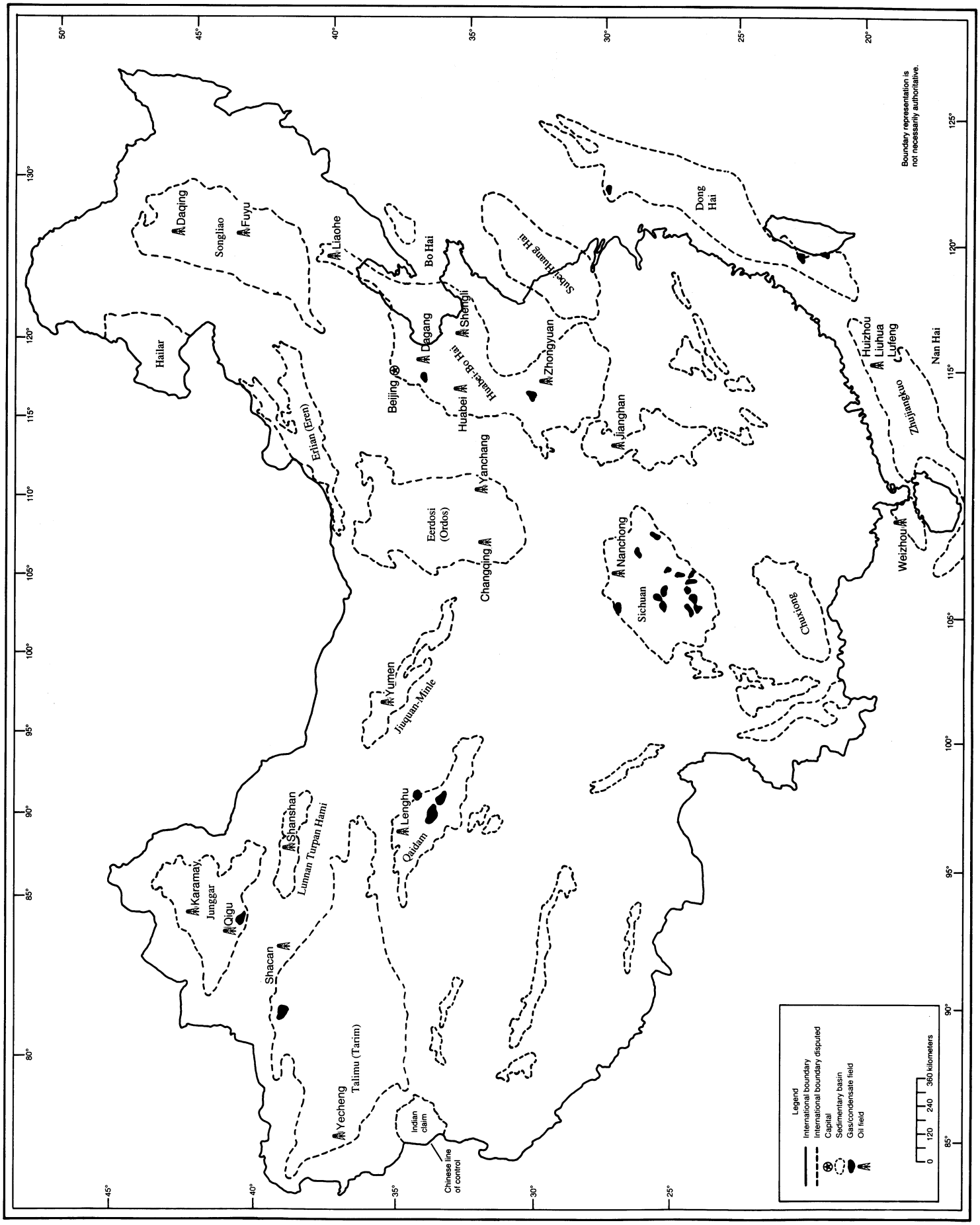


LOCATION OF MAJOR ORE DEPOSITS AND IRON AND STEEL WORKS IN CHINA



COAL RESOURCES IN CHINA

OIL AND NATURAL GAS RESOURCES IN CHINA



THE MINERAL INDUSTRY OF

CHINA

By Pui-Kwan Tse

A new phase in China's reform occurred during the Eighth National People's Congress (NPC) in March 1993. NPC ratified the recommendation on changing the country from a planned economy to a socialist market economy. The proposed plans and strategies were to broaden and deepen the reform process to transform the economy into a fully market-based economy. An important aspect of economic restructuring was to redefine the role and functions of Government in the economy. The Government would withdraw from its traditional tight control of enterprises and would focus on establishing an effective macroeconomic management system. NPC stressed the need to develop and improve the economic infrastructure, enabling markets to operate efficiently, and establish and improve the social security system for workers. Also, it was essential to change the parochial attitude of local governments in breaking down internal protectionism in trade and in moving labor and capital for the establishment of national markets.

China's economic growth continued in 1993. According to the State Statistics Bureau of China, the gross domestic product (GDP) increased by 13.4% in 1993. Industrial output grew 21.1% over that in the previous year. The per capita GDP reached $457[1] in 1993. The average inflation rate was reported at 14.7%. However, prices on consumer goods grew more than 20% in the largest 35 cities. The price of construction raw materials shot up by almost 45%, including that for steel, timber, rubber, cement, and chemicals. Investment in fixed assets in the first 6 months of 1993 increased by 70% over that of the previous year. In foreign exchange centers (swap markets), where buying and selling of hard currencies is under Government supervision, the renminbi (RMB) to US$ rate was up to 11 in the first week of June in 1993. However, the exchange quotations published by the State Administration of Foreign Exchange Control was 5.8 to 1. In mid-June, the Government tightened its control of loan credit and posted a 16-point minire-trenchment plan to cool off the over-heating economy. The People's Bank of China, the country's central bank, raised interest rates and ordered provincial branches to retrieve all unapproved Government bank loans. Industrial production, which reached a peak of 30% in July, dropped to 19% in September. However, under the miniretrenchment plan, the supply of money was tight especially in the southern Provinces of Sichuan, Hunan, Hubei, and Jiangxi. Local governments and enterprises had difficulties in paying IOU's issued to farmers and workers. However, the Government insisted that local governments and enterprises honored their IOU's to farmers and workers. Therefore, many enterprises had to cash in their U.S. dollar holdings to pay for their IOU's. This type of transaction and Government intervention in price ceilings for foreign exchange trading stabilized the RMB to US$ rate at 8.5 for the next several months in the swap market.

Meanwhile, controls caused new debt interconnections. Nationally, more than $100 billion in debts was involved among the steel, automobile, machinery, chemical, and textile industries. For example, steel consumers owed the equivalent of more than $2 billion to the 10 largest steel plants. The Benxi Steel Plant could only pay workers one-half of their normal salaries. Anshan Iron and Steel Complex (Angang) owed $300 million in taxes. All of the 10 largest steel plants were facing cash shortage difficulties. Many plants were forced either to reduce or stop production.

The estimated total population of China was 1.185 billion in 1993, an increase of 13.46 million over that of the previous year.

GOVERNMENT POLICIES AND PROGRAMS

During a meeting of a plenum of the Central Committee of the Communist Party of China (CPC) in November 1993, the committee resolved to adopt economic reform in 1994 in China. In 1994, major reforms were to include macroeconomic controls on finance, tax, and investment systems. China planned to make a drastic overhaul of its tax system by simplifying collection procedures and boosting the central Government's dwindling share of revenues. A uniform 33% tax rate on all enterprises was to replace the 55% levied on large- and medium-size enterprises. Preferential taxes on foreign enterprises and joint ventures would not be affected initially, but their taxes would eventually be brought in line with the rate of those on domestic enterprises. A value added tax would be applied at a uniform rate of 17% on all goods in circulation, but an additional excise tax would be levied on luxury items such as cigarettes, alcohol, cosmetic products, gas, and petroleum. An average mineral resource fee or tax of 4% would be levied on each mining operator. Before 1994, the Provincial governments and the central Government adopted the tax-on-revenue scheme. Each province was asked to pay a contracted amount of tax per annum based on a mutually agreed upon growth factor. The scheme would change eventually from a contracted amount to a percentage share of the province's revenue.

Beginning on January 1, 1994, China

replaced the official two-tier exchange rate with a single rate. The RMB-US$ exchange rate was expected to be devalued by about 33%, and the People's Bank of China would post exchange rates daily.

The Chinese Government planned to transform the People's Bank of China into a truly independent central bank. In the past, the People's Bank of China had monopoly power that was used as a tool by the central planners. The bank did not set the interest rate nor the country's money supply inasmuch as the State Council and the Central Planning Commission were the Government's policymakers. Whenever state-owned enterprises needed money, the bank was required to lend to them. Beginning in 1984, the People's Bank of China began to change from being a major lender to an institution making and implementing monetary policy. At the same time, the Government established three banks—the Agricultural Bank of China, Construction Bank of China, and Industrial and Commercial Bank of China. The three banks were to make loans to state-owned enterprises. However, the People's Bank of China remained caught up in the complex relationship between the State Planning Commission and state-owned enterprises, and between the Provincial governments and the Central Government. Questionable loans had been made by the People's Bank of China and by the other three banks in the past several years. Most of these loans were used to maintain guaranteed employment and social services of state-owned enterprises. In 1994, the Government planned to establish three policy decisionmaking banks—the China Agricultural Development Bank, Import and Export Credit Bank, and State Development Bank. The Government also planned to transform the Agricultural Bank of China, Bank of China, Industrial and Commercial Bank of China, and People's Construction Bank of China into state-owned commercial banks. These four were to operate as western-style commercial banks. The major functions of the People's Bank of China was to be a central bank by maintaining the stability of the currency and ensuring safe and effective operations in the country's financial system.

Beginning in the 1980's, China devoted significant attention to protect the enviornment. The National Enviornmental Protection Agency (NEPA) was established during the 1980's to supervise environmental protection, to promulgate national standard, and to establish environmental monitoring system. In 1989, NPC issued mineral resources laws and environmental protection laws to safeguard the country's natural resources and to maintain pollution levels.

PRODUCTION

The Government began an austerity program to reduce the outflow of currency. In June, steel companies curbed their imports of bar, rod, and other products. Some companies even canceled orders. The foreign currency situation was very tight throughout the second half of 1993. The sudden slowdown in demand and orders from China was felt by steel producers worldwide. Steel bar and rod prices in the Pacific rim were lower in the second half of 1993. China's major production of mineral commodities is shown in table 1.

In 1993, China produced 235.7 Mmt of iron ore. However, China's iron ore is low grade and contains an average of only 30% iron. In terms of iron content, China's iron ore production ranked behind that of Australia and Brazil. Despite the efforts to increase output of iron ore, domestic mine production still failed to meet demand. According to China's customs statistics, China imported 25.11 Mmt of iron ore in 1993, an increase by 30% from that of 1992. Imports were mainly from Australia, Brazil, and India.

Since 1993, prices for steel products have risen sharply due to the increasing demand for steel by the construction sector. In early 1993, the domestic market price of pig iron, an intermediary product used in steelmaking, was $175 per ton. By mid-August, the price had increased to $340 per ton. In Chengdu and Wuhan, the price of pig iron reached $400 per ton.

China also imports steel scrap. However, its ship-breaking industry also provides scrap metal for the domestic markets. In 1992, ship breaking yielded a total of 2.2 Mmt of steel. While ship dismantling is labor intensive, the country has low wages and a large labor force. The ship-breaking industry has become one of the major sources of the country's scrap steel.

Nonferrous metals prices in the world market generally were down and the metals market was sluggish in 1993. However, the demand for nonferrous metal in China increased in 1993. According to China National Nonferrous Metals Import and Export Corp. (CNIEC), a subsidiary of China National Nonferrous Metals Industry Corp. (CNNC), China experienced a deficit in trade of nonferrous metals in 1993. Imports of metallurgical-grade alumina increased by more than 20% in 1993 from those of 1992. With the rapid development of the Chinese economy, the demand for aluminum metal grew, accompanied by domestic price hikes. However, exports of aluminum metal increased and imports decreased in 1993. Nevertheless, China remained a net importer for aluminum metal and products during the year.

China's output of copper continued to fall short of demand. In 1993, China produced 690,000 tons of copper metal but consumption was about 900,000 tons. Despite a growing demand for copper in the domestic market, copper metal price remained stable at about RMB17,000 per ton because of imports of unwrought copper and copper alloy. Total metal imports increased over those of the previous year by 6% to 571,861 tons in 1993. Due to a higher import tax and to service taxes, the imports of copper concentrate decreased by 29% to 240,000 tons in 1993. In April, the Government also reduced the import tax on finished copper products from 6% to 4%. There was no reduction of the import tax on copper concentrate and scrap.

China is a significant tin producer in the world, and its tin output was expected to reach 43,000 tons in 1993. Domestic consumption of tin, however, was esti-

mated to be only 15,000 tons in 1993. Tin is one of China's traditional export commodities. China exports more than 20,000 mt/a of tin metal and products. In 1993, China exported 40,703 tons of tin metal and products, up 34% from that of previous year.

The domestic tin price varied throughout the year. The tin metal price ranged between RMB52,000 per ton and RMB55,000 per ton. The domestic demand for tin increased. Since the Government implemented a miniretrenchment plan, the price of tin dropped to RMB40,000 per ton. The domestic tin price remained higher than that in the international market. China's exporters, however, increased the tin export volume because the Government allowed a tax reimbursement for tin exports. This allowed exporters to be able to earn a profit and foreign currency for its tin transaction. In 1993, China joined the Association of Tin Producing Countries (ATPC) and pledged to reduce its tin exports to 20,000 tons in 1994.

Phosphate rock used for chemical fertilizers is mainly produced in Guizhou, Hubei, Hunan, Sichuan, and Yunnan. The production from these Provinces accounts for 97% of the country's total mine output. Low-grade phosphate rock makes up about 80% of the total resources. Most of the phosphate cannot be directly used for the production of high density fertilizers. According to the Government, the domestic demand for phosphate was 20 Mmt in 1993. To meet the demand, domestic production was to be 18.5 Mmt and the balance was to be met by imports. China's imports of phosphatic fertilizers have averaged 400,000 mt/a. Lack of rail transport capacity has restricted the growth of this sector. Each year, phosphate rock is stockpiled in Guizhou and Yunnan waiting to be shipped to other parts of the country.

China has moved from being the world's largest soda ash importer to self-sufficiency. Currently, the total domestic soda ash production capacity is 5.37 Mmt/a. The domestic soda ash demand was 4.5 Mmt in 1993: 1.35 Mmt for light industry, 30,000 tons for textiles, 900,000 tons for building materials, 500,000 tons for the chemical industry, 200,000 tons for the metallurgical industry, and the remainder for other industries.

China's nonferrous metals industry was to expand its co-operation with foreign countries to support the economic growth of the country. The Government drafted foreign investment regulations to allow foreign interests in the exploration and development of China's minerals. The foreign investment regulations were expected to be published in 1994. According to officials of CNNC, the foreign co-operation strategy can be summarized into three parts: (1) to attract investment in its corporation, (2) to involve mining and manufacturing in other countries, and (3) to expand its trade. For CNNC to survive in the competitive world market, it believed it must be active in both domestic and international resources and markets. CNNC planned to generate funds from international financial institutes. To attract foreign investors into the nonferrous sector, CNNC was to restructure several existing enterprises into shareholding firms.

According to the country's economic development plan, China was to produce 4.5 to 5 Mmt of its 10 nonferrous metals—aluminum, antimony, copper, lead, magnesium, mercury, nickel, tin, titanium, and zinc in the year 2000. In 1993, China produced 3.27 Mmt of these metals.

CNNC planned to reduce its 1.01-million-employee work force by one-third in the next 7 years. Overstaffing was a major problem and hindered CNNC's reform to compete in the world market. Surplus workers were encouraged to join CNNC's collective-owned subsidiaries or to enter private enterprises.

CNNC planned to invest about $1 billion per year in nonferrous mining projects aboard. Its investment priority was to be on bauxite and copper. China's bauxite and copper resources were poor in quality and required complicated ore dressing processes. China spends much needed foreign currency to import alumina and copper to meet domestic demand. CNNC has sent investigative teams to Australia, Canada, Chile, the Commonwealth of Independent States, Mongolia, Pakistan, Peru, the United States, and Zambia to look for potential investment projects in the past several years.

The Japan International Corporation Agency and the Metal Mining Agency of Japan signed an accord with CNIEC, to explore a 150,000-km^2 area that entends from Mian Xian in Shaanxi Province to Yuan Jiang in Yunnan Province. The area was expected to be one of China's richest belts for deposits of copper, lead, nickel-cobalt, and zinc. Exploration was to begin in 1994.

TRADE

According to the Customs General Administration of China, total foreign trade reached $195.72 billion in 1993, accounting for almost 40% of China's gross national product. The value of imports was $103.95 billion, an increase of 29% over that in the previous year. The value of exports was $91.77 billion, up 8% from that of the previous year. After 3 consecutive years of a favorable trade balance, China registered a trade deficit of $12.23 billion in 1993.

Japan replaced Hong Kong to become China's largest trading partner in 1993. The total value of trade between Japan and China was $39.04 billion, up 53.9% over that in 1992. This was followed by Hong Kong, with $32.54 billion; the United States, with $27.65 billion; and Taiwan, with $14.39 billion.

However, there is a wide discrepancy between United States and Chinese trade statistics. The United States International Trade Commission reported exports of $8.6 billion to China in 1993 and imports of $31.4 billion from China, resulting in a bilateral trade deficit for the United States of $22.8 billion. While China reported exports to the United States of $17.0 billion and imports of $10.7 billion from the United States, for a Chinese trade surplus of $6.3 billion.

China's principal exported commodities were shoes, toys, plastic products, textile, and crude oil. Each of these had a value of more than $1 billion in 1993.

Major commodities that China imported in 1993 were oil products, fertilizer, copper ore, metal processing machinery, communication equipment, and airplanes.

The Ministry of Foreign Trade and Economic Cooperation (MFTEC) published regulations for quota controls on export commodities. Mineral and metal commodities under quota control were antimony, caustic soda, cement, coal, coke, crude oil, iron alloy, limestone, magnesium, refined oil, rolled steel, soda ash, talc, tin, tungsten, and zinc. According to the General Administration of Customs, China reduced the import tariff rate beginning December 31, 1993, on chromium, copper, germanium, petroleum, vanadium, and other raw materials, machinery, and equipment that the Government considered in short supply. China's decision to reduce import tariffs may help its admission to the General Agreement on Trade and Tariffs (GATT).

Officials from the Ministry of Internal Trade emphasized the use of domestic materials as part of China's production reform. Under a mandatory distribution plan of the Government, the number of materials under state control for allocation and distribution was reduced from 256 in 1992 to 27 in 1993. Domestic supplies of these commodities did not meet demand. Materials under the mandatory distribution plan include cable and wire, cement, copper, heavy oil, heavy-duty trucks, lead, steel products, and timber. All other products not on the controlled distribution list were allowed to enter the market freely.

STRUCTURE OF THE MINERAL INDUSTRY

All Chinese large minerals and metals enterprises are state owned. However, there is considerable overlapping of authority over various mineral and metals commodities. The Ministry of Metallurgical Industry (MMI) is responsible for barite, iron ore, iron, manganese, and steel production, as well as some magnesite and dolomite mines and plants. CNNC is in charge of nonferrous metals and byproduct output of bismuth, gold, and silver. Gold production is under the supervision of the China National Gold Corp. The Ministry of Chemical Industry has responsibility for boron, potassium, phosphate, salt, sulfur, various inorganic salts, and chemical fertilizers. The China Nonmetallic Mineral Industry Corp. is responsible for the operation of mines and processing facilities for a wide array of industrial minerals and their subordinate processing enterprises. The State Administration of Building Materials is responsible for cement, dolomite, limestone, sand and gravel, and stone aggregates used for construction. For the energy sector, the Ministry of Coal Industry (coal); China National Petroleum and Natural Gas Corp., generally known as China National Petroleum Corp. (CNPC) (onshore oil and natural gas); China National Offshore Oil Corp., (oil and natural gas); and China National Nuclear Corp. (uranium) are responsible for all aspects of energy exploration, production, or mining.

COMMODITY REVIEW

Metals

Aluminum.—CNNC, Aluminum Co. of America (Alcoa) of the United States, and Kobe Steel Ltd. of Japan agreed to co-operate in developing China's aluminum sector. The agreement included technical assistance from Alcoa and Kobe to upgrade China's technology in the aluminum sector and for the construction of greenfield refineries.

China is the world's seventh largest alumina producer and sixth largest aluminum metal producer. In 1994, it had an annual output capacity of 2.8 Mmt of alumina and 1.4 Mmt of aluminum. In the fourth quarter of 1993, the Government reintroduced the restriction of using the metal and its alloy in the construction industry to moderate aluminum demand. CNNC and local authorities invested in several key aluminum projects to help alleviate the demand in the next century. Key development projects underway are the Maochang bauxite mine and the Kaili Aluminun Plant in Guizhou Province, the Pingguo Aluminum Co. in Guangxi Zizhiqu, the Shanxi Aluminum Plant in Shanxi Province, and the Zhongzhou Aluminum Plant in Henan Province.

Copper.—In recent years, the Government increased investment in prospecting copper resources in China. China lacks both large and rich copper mines. Low-grade ore makes up 80% of the total copper mines in China. According to the country's economic development plan, China will need about 1.2 Mmt of copper in the year 2000. Therefore, the Chinese Government has spent more than $5 million annually to look for copper prospects. A group of new copper deposits was found: Huashugou and Nanqidai in Gansu Province, Leuyang in Shaanxi Province, Longbohe in Yunnan Province, and Ashele and Xiangshan in Xinjiang Zizhiqu. Besides domestic prospects, China was interested also in purchasing the Altamira copper deposit in Chile.

Asia Minerals Corp. of Canada signed an initial joint venture agreement with the Altay Regional Government of Xinjiang Zizhiqu to evaluate and develop the Ashele copper-zinc sulfide deposit. The Ashele deposit contains geological reserves of 24 Mmt grading 3.1% copper and 1% zinc. The deposit contains significant values of gold, lead, and silver. According to the agreement, if a prefeasibility study is favorable for developing the deposit, Asia Minerals Corp. has the right to obtain up to a 60% interest in the joint venture to develop and operate the Ashele Mine.

Huludao Zinc Smelter, a subsidiary of CNNC, completed construction of its 60,000-mt/a copper cathode plant in 1993. The plant started trial runs in October. The copper is destined for the domestic market.

Iron and Steel.—The iron and steel industry produced 87.3 Mmt of pig iron and 88.7 Mmt of crude steel in 1993. China replaced the United States to become the second largest crude steel producer in the world after Japan. China

planned to speed up the construction of large- and medium-size iron and steel projects and to continue the expansion of iron ore mining capacity to meet demand because of increased output of a variety of ferrous products. The Ministry of Metallurgical Industry (MMI) is looking for foreign partners in the next several years to maintain stable growth in the iron and steel industry. MMI planned to spend $1 billion or 20% of the total capital investment in the iron and steel industry to renovate old mines with latent production capacity and to build new mines. MMI has drawn up a plan to build an iron and steel production base on the Chang Jiang (Yangtze River) in the 1990's. MMI targets steel production from plants along the river to be more than 48% of the country's total output in the year 2000. This would be close to 50 Mmt of steel in 2000. MMI estimated that for each additional ton of new output capacity, a capital input of $1,150 at current prices would be required. A large investment is required to renovate and to expand the iron and steel enterprises along the Chang Jiang. In addition, only 25% of the technology and equipment currently used by China's iron and steel sector is relatively advanced. Most of the key iron and steel enterprises consume about 40% more energy than those in western countries. Less than 30% of the steel output capacity has continuous casting equipment. Labor productivity is below international levels. MMI urged the iron and steel enterprises to speed up the development of continuous casting technology and to promote the optimal use of up-to-date steel smelting and rolling technology. Enterprises were to focus on upgrading and applying new technology to improve output productivity and developing on domestic iron ore mines. To generate funding, the Government approved Ma'anshan Iron and Steel Works (Magang) and Wuhan Iron and Steel Works (Wugang) to list their stocks in Hong Kong. Magang, which obtained $500 million in funds through listing on the Hong Kong Stock Exchange, became the largest Chinese company listed abroad in 1993.

The demand for steel pipes for the oil and other energy sectors is growing, but the industry produces less than 40% of this demand. Less than 70% of the domestically made steel products meet international standards. Therefore, most of the high-quality steel products are imported. China continued to be in short supply of cold-rolled silicon steel sheet, galvanized plate, and tinplate. China is also short of stainless steel. In 1993, the total demand for stainless steel was 400,000 tons, but domestic steel plants could only supply 250,000 tons.

Brazil's Companhia Vale do Rio Doce (CVRD) and MMI signed a protocol on a joint-venture project to mine iron ore at CVRD's massive Carajas project in northern Brazil. The project included installation of a new mining unit at Carajas, with investments estimated at $20 million. CVRD retained a 51% control of equity shares in the project. Initial output would be 6 Mmt of iron ore per year. The Carajas ore, one of the highest grade deposits in the world, contains 62% elemental iron.

Angang is the largest iron and steel producer in China. Currently, Angang has an annual production capacity of 26 Mmt of iron ore, 8.2 Mmt of pig iron, and 8.5 Mmt of crude steel. The Government approved Angang's expansion plan to produce up to 10 Mmt of crude steel in 1994. To ensure sufficient funds for this expansion plan, the state will provide preferential policies for Angang in taxation and in its depreciation rate of fixed assets. Starting in 1994, the Government was to lift the price ceiling on Angang products.

Angang and Australia's Portman Mining Ltd. signed an agreement to develop the Koolyanobbing Mine and an associated plant in Western Australia. Portman's subsidiary, Portman Resources, held 60% and Angang's subsidiary, Angang Australia, held the remaining 40% in the joint venture. The mine is 370 km east of Perth. Construction of the Koolyanobbing Mine and the Cockatoo Island plant will cost about $19 million. The mine will have a total output capacity of 2 Mmt consisting of 1.1 Mmt of fines and 0.9 Mmt of lump ore. The mine has an estimated reserve life of 25 years. Initial output will be 1.5 Mmt of ore with an ore grade of 63% iron. The Cockatoo Island plant will produce 600,000 tons of high-grade fines averaging 66.5% iron containing 0.03% phosphorus. Shipment of iron ore fines is expected to begin in July 1994 from the Port of Esperance to China. Under the development proposal, Angang will buy all the iron ore fines from the mine for a period of 20 years and all the concentrate from Cockatoo Island for 6 years. The lump ore produced at the mine will be sold to Japanese and other Chinese customers.

Shoudu Iron and Steel Complex (Shougang) secured its financial investment of Qilu Iron and Steel Co. in Jining, Shandong Province. Shougang holds 50% of the share in the joint venture. Shandong Province holds 5% and Shougang's partner Cheung Kong Holdings in Hong Kong and other foreign partners hold the remaining 45%. The first phase construction will cost $6 billion and have an annual output capacity of 5 Mmt of steel. The steel mill, which Shougang purchased from California Steel Co., will be used as part of the first phase equipment. Qilu's annual production capacity will be expanded to 10 Mmt of steel during the second phase of the project.

Beginning in 1992, Shougang and its Hong Kong partners became active in Hong Kong's stock market. In October 1992, Shougang, Cheung Kong Holdings, and CEF Capital invested more than $30 million for a 77% stake in Tung Wing Steel, a local construction steel trading firm, and renamed it as Shougang Concord International. In 1993, Shougang Concord acquired controlling interest in two listed companies—Santai Manufacturing, a maker of industrial electronic components, and Eastern Century, a metals trader. Then, Shougang teamed up with its Hong Kong partners, including Cheung Kong and Grand Development Corp., owned by the younger son of Deng Xiaoping, and bought Kader Investment, a property holding company, and renamed it as Shougang Concord Grand. Shougang Concord Grand took over controlling

shares in local property developers—Hoi Sing Holdings and Paul Y-ITC Construction Holdings. Shougang also placed its subsidiary, a steel plate manufacturer in Qinhuangdao, Hebei Province, into Shougang Concord. Shougang wanted to use Hong Kong as a base for establishing its international expansion in the 1990's. Shougang decided to diversify its activities into engineering, finance, real estate, and trade operations.

Baoshan Iron and Steel Complex (Baogang), China's third largest steel producer in 1993, and Hong Kong steel trader Van Shung Chong set up a joint-venture company, Bao Shung Chong to import rebar and billets. The joint venture aimed to serve the Shanghai market and also to handle exports of Baogang's flat-rolled products. The purpose of Baogang to acquire shares in the joint venture was to give it stronger access to Hong Kong market information.

Baogang, the Zhejiang Provincial government and a U.S. steel company signed an agreement to form a steel-making joint-venture with each owning equal shares. The steel mill will be in Beican, Ningbo Shi, Zhejiang Province. The steel mill will have a designed capacity to produce 1.6 Mmt/a of steel.

Baogang ordered a hot rolling mill from the Mitsubishi Group of Japan as a part of its third phase expansion plan. The mill will have an annual capacity of producing 2.8 Mmt of tin-plated sheets, and silicon strips and sheets. A commissioning date for the project is expected to be in 1996.

The State Council approved plans for the Guangdong Provincial government to construct the Guangzhou Zhujiang Steel Plant in the Huangpu Economic and Technological Development Zone, Guangzhou, Guangdong Province. Construction of the $620 million steel plant was underway. The plant will import a high-powered electric furnace and a smelting furnace, each with a daily capacity of 160 tons of steel. Currently, Guangdong Province produces only about 30% of the steel it needs. The disparity between supply and demand was estimated at about 6 Mmt/a and the shortfall was expected to continue into the next century. The Provincial government continued to seek foreign investors for a $7.5 billion project, Zhanjiang Steel Plant, in Leizhou Peninsula.

Shenyang Steel Rolling General Mill of China and Toyo Steel Manufacturing of Japan formed a joint venture, Shenyang Toyo Steel Co., in Shenyang Shi, Liaoning Province. The electric furnace minimill will have an annual designed capacity to produce 240,000 tons of billets. The new company to be capitalized at $42 million is a 60-40 split between Toyo Steel and Shenyang Steel. Much of the investment will go toward the installation of a 40-ton electric furnace and a billet caster.

Gold.—Gold is a symbol of wealth, luck, and well-being in China. It is worn as jewelry or invested as a hedge against inflation. According to governmental statistics, China consumed about 250 tons of gold in 1992. This figure does not include nonresidents of China who bring in gold jewelries as gifts to their relatives. China has become one of the world's largest gold consumers.

China's gold production, operations, and management remained under the planned economy. Under the current regulations, gold information is considered a state secret. The Chinese Government does not reveal its geological reserves of gold and data on gold production. China has about 500 gold mines. Proven gold reserves have increased tenfold since 1975. As part of economic reform, China planned to open certain gold deposits which need advanced technology and funds for development to foreign investors in 1994.

The People's Bank of China is the monopolized agent on behalf of the state on buying and selling gold. Under the rule, the bank is empowered to acquire all gold produced in China. In the beginning of 1993, the state-set purchasing gold price was RMB 50 per g. and was resold to jewelry factories at RMB 110 per g. In July, the Government increased the purchasing price to RBM 96 per g. The domestic market gold price was set by the Government at about RBM 150 per g.

Other Metals and Industrial Minerals.—The Xinjiang branch of CNIEC signed a contract with Gwalia Consolidated Ltd. of Australia to purchase 60,000 tons of spodumene (lithium) concentrates from Gwalia's Greenbushes Mine in the next 3 years. The contract was worth about $6.7 million. Gwalia Consolidated Ltd. planned to establish spodumene stockpiles in China, Indonesia, and Thailand. Gwalia Consolidated was to diversify from the traditional European markets into the fast growing Asian region.

Asia Minerals Corp. of Canada completed a feasibility study of the Qiandonshan lead-zinc deposit in Shaanxi Province. The shallow underground deposit has probable reserves of 12.2 Mmt of ore grading 1.7% lead, 7.9% zinc, and 22 g/mt silver. Currently, Qiandonshan is being mined at 200 mt/d. An estimated investment cost of $25 million will be required for the expansion to mine 1,200 mt/d ore. At full production, the mine would produce 8,000 tons of lead concentrate and 50,000 tons of zinc concentrate each year. Because of a favorable feasibility study, Asia Minerals Corp. acquired a 55% interest in the project. The other partners are CNNC and the Shaanxi Provincial government.

China is one of the large producers of rare earths. There is keen competition in the international marketing of rare earths. Because of worldwide pricing, 13 Chinese producers and traders agreed to adopt uniform prices for the export of rare earth products beginning in 1994. A minimum price for each commodity was to be established. The State Planning Commission continued its ban on foreign investments in domestic rare earths mining projects. However, foreign investments in rare earths metallurgical processes using advanced technology for extraction and separation were exceptions to the ban.

China commissioned its first silver complex encompassing mining, processing, and smelting operation in Zhushan Xian, Hubei Province. Processing capacity was reported at 400 mt/d of ore. The project took 6 years to complete at a cost of $12 million.

Shanghai Pacific and ICI Inc. were negotiating the formation of a joint venture to produce titanium dioxide. The project is one of six potential joint ventures planned by ICI in China. The plant would have a capacity to produce 50,000 mt/a of titanium dioxide and use the sulfate technology. The plant would be identical to the recently completed plant at Telok Kalong, Malaysia, by ICI. China's ilmenite reserves are mainly in Guangdong and Hainan Provinces. However, the partners felt that it is easier to import raw materials from Australia and Malaysia because of inadequate land transportation facilities in southern China.

Jinzhou Ferroalloy Works and Astron Resources Ltd. agreed to form a 50-50 joint-venture to process and sell a range of zirconium-base chemical products in Jinzhou Shi, Liaoning Province. The injection of a $2 million fund from Astron Resources Ltd. will be used to expand Jinzhou's existing zirconium processing capacity.

Fuels

The increase in demand spurred by China's economic boom in the past 2 years overwhelmed domestic production. China became a net importer of $2.3 billion of crude oil and refinery products in 1993. China planned to raise oil prices in May 1993. This brought domestic subsidized oil prices within the international price level. Because of the high inflation rate during the first quarter of the year, the Government decided to delay raising the domestic oil prices. During 1993, about one-half of the domestic oil output was sold at the subsidized price of $95 (RMB 550) per ton. There are three different prices for oil in China—the official price, $34.5 (RMB 200) per ton; the state-set price, $86.2 (RMB 500) per ton; and the market price, $237.9 (RMB 1,380) per ton.

China's second nuclear powerplant, with a capacity of 900 MW at Daya Bay, Guangdong Province, began trial operations in 1993. The first of the two generating units in the plant will begin operation in February 1994. Full commercial operation is expected by the end of 1994. The second is expected to begin trial operation in the second half of 1994. The plant is a 75-25 joint venture between the Guangdong Nuclear Power Investment Co., a subsidiary of China National Nuclear Corp., and the Hong Kong Nuclear Power Investment Co. Ltd., a subsidiary of China Light and Power in Hong Kong. Seventy percent of the electricity will be supplied to Hong Kong in the first 15 years to repay the loans. Thirty percent of the electricity will be supplied to the Guangzhou area, which has about a 30% shortfall in power demand.

The Guangdong Provincial government announced that two more nuclear powerplants will be contructed in Daya Bay and Yangjiang. The Yangjiang nuclear powerplant will have four units with a combined capacity of 4 MkW. Contruction of the plant is expected to begin in 1995 and to begin operation before the year 2000. The Daya Bay nuclear powerplant will be 5 km away from the main plant. The plant also contains two units each with a capacity of 900 MW.

Coal.—China is a big producer and consumer of energy resources. Coal use accounts for 75% of primary energy resources. With the current Government policy, coal will continue to be China's main energy resource. There are two major problems in China's coal usage. First, China's coal resource is unevenly distributed geographically. More than 75% of China's proven coal reserves are in north and northwest China and coal relies mainly on the railway for transport to the consuming regions in east and south China. Transport bottlenecks have been one of the major restraints for coal shipments. Currently, a substantial portion of China's railway capacity is utilized to haul coal. Secondly, increasingly serious atmospheric pollution and also ecological destruction result from burning large amounts of coal. China generates about 15 Mmt/a of carbon dioxide and is one of the largest emitters of greenhouse gases in the world. Coal dust density is about five times higher than that of World Health Organization standards in the air of northern cities of China, while the south suffers from acid rain.

The coal industry was hamstrung under the central planning system. Laden with the problems created by a planned economy, the coal industry had difficulties in gearing itself for a free market. An excess of unnecessary workers in state coal mines resulted in inefficiency and deficits. The major state-owned mines, which produced a total of 480 Mmt of coal, employed 3.6 million people, more than the world average for that level of output. The Ministry of Coal Industry was reestablished under the State Council during the restructuring of the Government in March 1993. Its senior officials recommended a comprehensive development strategy for the industry that would invite investment from foreign countries and from domestic sectors. The Ministry also encouraged subsidiaries to diversify assets and to invest in the power, chemical, railway, and metallurgical industries. The Ministry was drafting a comprehensive coal law so there would be unified regulations from issues concerning efficient resources exploitation, environment protection, to relations between coal mines and regional authorities of coal consumers.

The Ministry of Coal Industry began its management of coal mines as free market enterprises. However, most of the funds it received continued to be channeled through state banks. Reportedly, the late arrival of approved state loans hampered the coal industry's plan for new mine construction, technical renovation, jobs for laid-off workers, and other reform programs. The Ministry of Coal Industry and other related ministries submitted appeals to the State Planning Commission and the State Council to force the banks to grant approved loans.

The State Council in 1993 approved the construction of Haishiwan Mine in Honggu District of Lanzhou Shi, Gansu Province. The mine has geological coal reserves of 243 Mmt. Mine life was estimated to be 81 years. Mine construction was expected to cost about $55 million and would take 6 years to be complete. This would help to ease the

serious coal shortage in the Provinces of Gansu and Qinghai.

The first phase construction of the Shenfu-Dongsheng Coalfield on the border of Shaanxi and Nei Mongol was completed in 1993. Currently, the coalfield has the capacity of producing 10 Mmt/a of coal. Construction of the mine was integrated with the construction of road, power, ports, and airports. All work, including production, supply, and marketing, was undertaken by the Huaneng Float Coal Corp., a state-owned enterprise. The 170-km Baotou-Shenmu railway with an annual capacity of 10 Mmt of freight was also opened. The 580 km Shenmu-Huanghua railway and Huanghua port specializing in shipping coal with an annual handling capacity of 30 Mmt of coal was under construction.

Petroleum.—In 1993, China produced 144 Mmt of crude oil, including 139.2 Mmt from onshore sources and 4.8 Mmt from offshore, an overall increase of 1.3% over that of the previous year. Daqing Oilfield remained China's largest producer, accounting for 38% of China's total output. Daqing's production level was expected to continue in the next several years. Each of the outputs of the Dagang, Liaohe, and Xinjiang Oilfields increased in 1993. Production by the other major oilfields in central and northeast China began to drop in annual output. According to CNPC, China increased oil exploration in east China as part of its efforts to maintain the current output level of 124 Mmt in the region. This was the Government's strategy of "stabilizing oil production in the East and developing the resources in the West." This eastern region encompasses the area north of Chang Jiang and east of the Taihung mountain range along the boundary of Hunan and Shanxi. Reserves in this region estimated by CNPC are about 33.5 billion tons of oil. Output of crude oil in the region at the current annual rate was necessary for the economic well-being of this industrialized area as well as that for the country. Oil exploration and development in west China was just beginning.

In October 1993, the Government published regulations on sino-foreign operation in the exploitation of onshore oil and gas in China. The Government authorized CNPC to be the responsible party for formalities in conducting the negotations and signing and executing the contracts. According to the regulations, foreign investors may transfer their share of oil abroad and remit recouped investments, profits, and other income to their home base.

The first bidding for onshore oil was on the southeastern part of Tarim Basin, Xinjiang Zizhiqu, in March 1993. The first contract on this bid was signed on December 20, 1993, between CNPC and a three-member partnership—U.S. Exxon (China) Co. Ltd., Sumitomo of Japan, and Indonesia Petroleum Co. Ltd. of Japan. The location was in the third regional block, southeast of the Tarim Basin within Qiemo Xian, with an area of 14,475 km^2. The contract stated that the foreign partners assumed the total cost and risk in the next 8 years in exploration. After the discovery of an oilfield and/or gasfield, both sides would develop and produce cooperatively and share the product according to the proportion provided under the contract. China can purchase the oil share from its foreign partners with U.S. dollars according to the international market oil price. The second contract will be signed in February 1994 between CNPC and a five-member partnership—Agip (Oversea) Ltd. of Italy, Elf of France, Japan Energy Corp., Japan Petroleum Exploration Co. Ltd., and Texaco (China) B.V. of the United States. The five-member partnership will jointly explore a 9,814-km^2 area block 1 in the Tarin Basin. The second bidding in areas of Hebei, Henan, Hubei, Gansu, Nei Mongol, Ningxia, Shangdong, and Qinghai will be announced in January 1994.

Sino-American Petroleum Development Co., a subsidiary of CNPC, signed a contract with Petrol Peru Co. in Lima for oil cooperative exploitation in the Tarala Basin, west of Peru, in the next 5 years beginning in October 1993. During the same period, CNPC bought two small oilfields in the southern part of Alberta, Canada. CNPC is also interested in acquiring exploration rights in Papua New Guinea and Thailand.

Reserves

China is the world leader in proven reserves of antimony, barite, molybdenum, rare earths, titanium, tungsten, and vanadium. China has 55 billion tons of iron ore, albeit with an average grade of only 30% elemental content. Moreover, only 5% of the ore reserves contain more than 40% iron. Major deposits occur in Anhui, Hebei, Liaoning and Nei Mongol. Major gold deposits are in Hebei, Heilongjiang, Henan, Hunan, Jilin, Nei Mongol, and Shandong. Bauxite deposits occur in Guangxi, Guizhou, Henan, and Shandong. Lead and zinc deposits are in Fujian, Gansu, Guangdong, and Guangxi.

With the exception of some commodities such as chromium, copper, and potash, China produces significant quantities of a wide array of minerals and metals, based on its production and/or export capability for these commodities.

INFRASTRUCTURE

An inadequate transportation sector and telecommunications system are majors factors hindering economic growth in China. The total capacity of its telephone network is targeted for 48 million units in 1995 and 65 million units in the year 2000. China is preparing a series of flexible policies to attract foreign investors in post and telecommunications, but it will not allow foreigners to be involved in management decision.

In the next 3 years, the Ministry of Railways will spend $15.9 billion on capital construction of new railways to meet the demands of China economic development. In a new development program, China will build 6,600 km of new lines, double-track 4,100 km, and electrify 5,600 km of old lines. China will gradually cut the mandatory plans for railway transportation. China will develop large containers, cold storage, and bulk freight in cargo transportation.

China will build 29 new airports in

southwest China in the 1990's. Airports to be built include Ganzi, Guangyuan, Jiangbe, Jiuzaigou, Mianyang, Neijiang, Qiangjiang, and Wanxian in Sichuan Province; Bijie, Tongren, Xingyi, and Zunyi in Guizhou Province; and Diqing, Lincan, Tengchong, and Wenshan in Yunnan Province.

OUTLOOK

China is one of the world's leading producers of industrial minerals, metals, and fuels. It plans to increase output capacity of aluminum, cement, copper, fertilizer, iron and steel, lead, nickel, salt, soda ash, and zinc. Despite an extensive minerals base, constraints based on a lack of both hard currency and advanced technology have forced the Chinese Government to delay capital investments in mine and plant construction and plant expansion. China also has opened the interior of the country for foreign exploration and development in an effort to increase the production of its fuel and nonfuel minerals sectors. China is expected to continue to be a major force in the world market for such commodities as antimony, barite, fluorspar, magnesite, rare earths, and tungsten. As the result of industrial development being achieved under its ambitious modernization program, China's industry will be technologically better suited to the production of value added manufactures and advanced materials, meeting international quality specifications. By the end of this century, China hopes to become a newly industrialized country.

[1]Where necessary, values have been converted from renminbi (RMB) to U.S. dollars at the rate of RMB5.8=$US1.00 for 1993.

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TABLE 1

CHINA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993	Annual capacity (Jan. 1, 1994)
METALS							
Aluminum:							
Bauxite, gross weight		2,388,000	2,400,000	2,600,000	2,700,000	3,500,000	6,000,000
Alumina, gross weight		1,350,000	1,460,000	r1,520,000	r1,583,000	1,900,000	2,800,000
Metal, refined, primary		750,000	850,000	963,000	1,100,000	1,220,000	1,400,000
Antimony, mine output, Sb content		61,000	54,800	r58,300	r59,400	50,000	90,000
Bismuth, mine output, Bi content		850	1,000	r1,260	r1,060	1,300	20,000
Cadmium, smelter		800	1,100	1,200	r1,150	1,100	20,000
Cobalt		255	325	300	220	300	600
Copper:							
Mine output, Cu content		276,000	r285,000	r304,000	r334,200	340,000	350,000
Metal:							
Smelter, primary and secondary		450,000	559,000	600,000	r700,000	730,000	800,000
Refined, primary and secondary		540,000	560,000	560,000	r659,000	690,700	800,000
Gold, mine output, Au content		90	100	120	140	160	200
Iron and steel:							
Iron ore, gross weight	thousand tons	171,850	168,300	176,070	197,600	234,660	250,000
Pig iron	do.	58,200	62,380	67,200	72,000	87,300	92,000
Ferroalloys	do.	2,382	2,400	2,460	2,650	2,800	30,000
Steel, crude	do.	61,200	66,100	70,570	80,000	88,680	94,000
Steel, rolled	do.	48,700	51,200	56,380	65,340	75,900	80,000
Lead:							
Mine output, Pb content		308,000	315,000	352,000	r330,200	405,000	440,000
Metal, refined, primary and secondary		260,000	296,000	330,000	r365,000	387,400	450,000
Magnesium metal, primary		3,500	5,900	8,600	r10,550	12,000	25,000
Manganese ore, gross weight	thousand tons	3,200	r4,080	r5,150	r5,300	5,400	6,500
Mercury, mine output, Hg content		1,200	1,000	r760	r580	650	1,500
Molybdenum, mine output, Mo content		15,700	15,700	r13,200	r19,200	16,000	25,000
Nickel:							
Mine		34,250	33,000	r30,400	r32,800	33,000	50,000
Smelter		25,600	27,500	28,900	r30,800	32,000	50,000
Silver, mine output, Ag content		125	130	150	170	200	300
Tin:							
Mine output, Sn content		40,000	42,000	r42,100	r43,800	46,000	70,000
Metal, smelter		29,500	35,000	r36,400	r39,600	51,500	65,000
Tungsten, mine output, W content		30,200	32,000	r31,800	r25,410	20,000	50,000
Zinc:							
Mine output, Zn content		538,000	619,000	r750,000	r758,100	900,000	1,000,000
Refined, primary and secondary		451,000	550,000	612,000	r719,000	838,000	900,000
INDUSTRIAL MINERALS							
Asbestos		181,000	221,000	r200,000	240,000	240,000	300,000
Barite	thousand tons	1,750	r1,700	r1,600	1,500	1,500	2,500
Boron, mine, B_2O_3 equivalent		74,000	75,000	r92,500	r95,000	100,000	140,000
Bromine		8,000	8,080	r12,100	r16,650	18,000	24,000

See footnotes at end of table.

TABLE 1—Continued

CHINA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993	Annual capacity (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Cement, hydraulic	thousand tons	207,000	203,000	252,610	304,000	356,000	400,000
Fluorspar		1,750,000	1,700,000	r1,920,000	r1,890,000	2,000,000	2,500,000
Graphite		490,000	455,000	289,000	300,000	310,000	650,000
Gypsum	thousand tons	9,020	10,180	10,500	11,000	10,600	15,000
Kyanite and related materials		2,500	2,500	2,500	2,500	2,500	3,000
Lithium minerals, all types		15,000	15,000	15,500	15,500	15,500	17,000
Magnesite	thousand tons	2,600	r2,170	r1,650	r1,510	1,500	3,000
Nitrogen: N content of ammonia	do.	17,000	17,500	18,000	18,000	19,000	25,000
Phosphate rock and apatite, P_2O_5 equivalent	do.	6,000	6,400	6,500	6,800	7,000	9,000
Potash, marketable, K_2O equivalent	do.	42	29	r32	r21	25	45
Salt	do.	28,000	20,000	24,100	28,100	29,530	35,000
Sodium compounds: Soad ash, natural and synthetic	do.	2,983	3,750	3,940	4,500	5,270	6,500
Sulfur:							
Native	thousand tons	300	320	320	320	330	400
Content of pyrite	do.	4,270	4,400	r4,940	4,500	5,000	6,000
Byproduct, all sources	do.	600	650	650	650	700	900
Total	do.	5,170	5,370	r5,910	5,470	6,030	7,300
Talc and related materials	do.	2,100	2,545	2,600	r2,500	2,300	3,000
MINERAL FUELS AND RELATED MATERIALS							
Coal:							
Anthracite	thousand tons	190,000	r212,850	r214,370	190,000	220,000	250,000
Bituminous and lignite	do.	850,000	r840,610	r875,630	920,000	920,000	1,300,000
Total	do.	1,040,000	1,053,460	1,090,000	1,110,000	1,140,000	1,550,000
Coke, all types	do.	66,200	73,280	73,520	75,000	62,690	100,000
Gas, natural:							
Gross	billion cubic meters	15	15	16	16	17	20
Marketed	do.	13	13	13	14	15	19
Petroleum:							
Crude (including crude from oil shale)	thousand 42-gallon barrels	1,004,000	1,008,000	1,014,700	1,050,000	1,058,000	1,300,000
Refinery products	do.	725,000	730,000	800,000	830,000	860,000	1,000,000

rRevised.

[1]Table includes data available through May 20, 1994.

TABLE 2

CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Aluminum:			
Alumina	China National Nonferrous Metals Industry Corp.	Guangxi, Pingguo	300
Do.	do.	Guizhou, Guiyang	400
Do.	do.	Henan, Zhongzhou	200
Do.	do.	Hunan, Zhengzhou	640
Do.	do.	Shandong, Zibo	500
Do.	do.	Shanxi, Hejin	1,200
Metal	do.	Anhui, Hefei	25
Do.	do.	Gansu, Baiyin	50
Do.	do.	Gansu, Lanzhou	82
Do.	do.	do.	95
Do.	do.	Guangxi, Pingguo	100
Do.	do.	Guizhou, Guiyang	160
Do.	do.	Henan, Jiaozuo	15
Do.	do.	Henan, Sanmenxia	20
Do.	do.	Jilin, Yanji	15
Do.	do.	Liaoning, Fushun	100
Do.	do.	Nei Mongol, Baotou	70
Do.	do.	Ningxia, Qingtongxia	82
Do.	do.	Qinghai, Xining	200
Do.	do.	Shaanix, Tongchuan	35
Do.	do.	Shangdong, Zibo	35
Do.	do.	Shanxi, Taiyuan	15
Do.	do.	Yunnan, Kunming	15
Asbestos	China National Nonmetallic Minerals Industry Corp.		
Do.	do.	Nei Mongol, Baotou	NA
Do.	do.	Shanxi, Lai Yuan	130
Do.	do.	Shanxi, Lu Liang	NA
Barite	do.	Guizhou, Xiangshou	NA
Coal	Ministry of Coal Industry	Hebei	70,000
Do.	do.	Heilongjiang	100,000
Do.	do.	Henan	100,000
Do.	do.	Liaoning	70,000
Do.	do.	Nei Mongol	90,000
Do.	do.	Shandong	60,000
Do.	do.	Shanxi	400,000
Do.	do.	Sichuan	80,000
Cobalt	China National Nonferrous Metals Industry Corp.	Hainan, Changjiang	1
Copper, refined	do.	Anhui, Tongling	30
Do.	do.	Gansu: Baiyin	45
Do.	do.	Jinchuan	30
Do.	do.	Wu Wei	35
Do.	do.	Henan, Zhuzhou	10

See footnotes at end of table.

TABLE 2—Continued

CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Copper, refined—Continued:			
Do.	China National Nonferrous Metals Industry Corp.	Hubei, Daye	30
Do.	do.	Jiangxi, Guixi	90
		Liaoning:	
		Huludao	60
Do.	do.	Shenyang	100
Do.	do.	Shanghai	80
Do.	do.	Shanxi, Taiyuan	35
Do.	do.	Tianjin	30
Do.	do.	Yunnan, Kunming	95
Gas, natural			
billion cubic meters	China National Petroleum Corp.	Sichuan	10
Gold, refined			
thousand kilograms	China National Gold Corp.	Henan, Kingbao	3
Do.	do.	Shandong, Laizhou	15
Do.	do.	Shandong, Zhaoyuan	6
Graphite	China National Nonmetallic	Shandong, Laixi	NA
Do.	Minerals Industry Corp.	Shandong, Pingdu	190
Iron and steel:			
Iron ore	Maanshan Iron and Steel Co.	Anhui, Maanshan	10,000
Do.	Shoudu Iron and Steel Co.	Beijing	20,000
Do.	Meishan Metallurgical Co.	Shanghai	2,000
Do.	Jiuquan Iron and Steel Co.	Gansu, Jiayuguan	4,000
Do.	Hainan Iron Mine	Hainan, Changjiang	4,600
Do.	Handan-Xingtai Metallurgical Bureau	Hebei, Handan	3,800
Do.	Tangshan Iron and Steel Co.	Hebei, Tangshan	3,000
Do.	Wuhan Iron and Steel Co.	Hubei, Wuhan	5,100
Do.	Banshigou Iron Mine Mining Co.	Jilin, Hunjiang	1,400
Do.	Anshan Iron and Steel Co.	Liaoning, Anshan	30,000
Do.	Benxi Iron and Steel Co.	Liaoning, Benxi	13,700
Do.	Baotou Iron and Steel Co.	Nei Monggol, Boatou	10,000
Do.	Taiyuan Iron and Steel Co.	Shanxi, Taiyuan	4,000
Do.	Dabaoshan Mining Co.	Guangdong, Qujiang	1,670
Do.	Panzhihua Mining Co.	Sichuan, Panzhihua	13,000
Do.	Kuming Iron and Steel Co.	Yunnan, Kuming	1,400
Ferroalloy			
Do.	Shoudu Iron and Steel Co.	Beijing	35
Do.	Northwest Ferroalloy Co.	Gansu, Yongdeng	60
Do.	Zunyi Ferroalloy Co.	Guizhou, Zunhi	100
Do.	Jilin Ferroalloy Co.	Jilin, Jilin	250
Do.	Jinzhou Ferroalloy Co.	Liaoning, Jinzhou	90
Do.	Liaoyang Ferroalloy Co.	Liaoning, Liaoyang	70
Do.	Shanghai Steel Co.	Shanghai	180
Do.	Emi Ferroalloy Co.	Sichuan, Emei	70
Do.	Hengshan Ferroalloy Co.	Zhejiang, Jiande	70

See footnotes at end of table.

TABLE 2—Continued

CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Iron and steel—Continued:			
Crude steel	Maanshan Iron and Steel Co.	Anhui, Maanshan	2,500
Do.	Shoudu Iron and Steel Co.	Beijing	10,000
Do.	Tangshan Iron and Steel Co.	Hebei, Tangshan	2,000
Do.	Wuhan Iron and Steel Co.	Hubei, Wuhan	6,000
Do.	Anshan Iron an Steel Co.	Liaoning, Anshan	10,000
Do.	Benxi Iron and Steel Co.	Liaoning, Benxi	2,700
Do.	Baotou Iron and Steel Co.	Nei Mongol, Baotou	3,500
Do.	Baoshan Iron and Steel Co.	Shanghai	7,000
Do.	Shanghai Steel Co.	do.	6,000
Do.	Taiyuan Iron and Steel Co. No. 2.	Shanxi, Taiyuan	2,500
Do.	Panzhihua Iron and Steel Co.	Sichuan, Panzhihua	2,500
Do.	Tianjin Iron and Steel Co.	Tianjin	2,000
Lead			
Do.	China National Nonferrous Metals Industry Corp.	Fujian, Lianchang	10
Do.	do.	Gansu, Baiyan	50
Do.	do.	Guangdong, Shaoquan	30
Do.	do.	Guangxi, Changpo	5
Do.	do.	Hunan, Hengyang	6
Do.	do.	Hunan, Zhuzhou	80
Do.	do.	Liaoning, Shenyang	70
Do.	do.	Yunnan, Lanping	20
Nickel, refined	China National Nonferrous Metals Industry Corp.	Gansu, Jinchuan	40
Petroleum, crude	China National Petroleum Corp.	Hebei, Shengli	33,350
Do.	do.	Heilongjiang, Daqing	55,000
Do.	do.	Liaoning, Liaohe	15,000
Do.	China National Offshore Oil Corp.	Bohai, Wan	
Do.	do.	Nanhai	5,000
Potash	Ministry of Chemical Industry	Qinghai	40
Rare earths	Ministry of Metallurgical Industry	Nei Mongol, Baiyunebo	12
Do.	China National Nonferrous Metals Industry Corp.	Jiangxi, Ganan	1
Do.	do.	Guangdong, Nanshanhai	5
Do.	do.	Shandong, Weishan	2
Salt	Ministry of Chemical Industry	Anhui	200
Do.	do.	Qinghai	320
Talc	China National Nonmetallic Mineral Industry Co.	Guangxi, Longshen	130
Do.	do.	Liaoning, Haicheng	50
Do.	do.	Shandong, Qixia	5
Tin, smelter	China National Nonferrous Metals Industry Corp.	Guangxi, Dachang	5
Do.	do.	Yunnan, Geijiu	15

See footnotes at end of table.

TABLE 2—Continued

CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Tungsten concentrate	China National Nonferrous Metals Industry Corp.	Guangdong:	
Do.	do.	Guangxi	
Do.	do.	Hunan	30
Do.	do.	Jiangxi	
Do.	do.	Zhejiang	
Zinc	do.	Gansu, Baiyan	100
Do.	do.	Guangdong, Shaoquan	70
Do.	do.	Guangxi, Liuzhou	32
		Hunan:	
Do.	do.	Hengyang	12
Do.	do.	Zhuzhou	200
Do.	do.	Liaoning, Huludao	180
Do.	do.	Liaoning, Shenyang	20
		Yunnan:	
Do.	do.	Lanping	40
		Kunming	10

NA Not available.

TABLE 3

CHINA: MINE OUTPUT OF SELECTED METAL ORES IN 1992

	Output (tons)	Mine ore grade	Concentrate grade	Metal recovery ratio in ore dressing
			(percent)	
Antimony (Sb content)	43,800	2.27	16.51	87.98
Copper (Cu content)	334,300	.63	22.32	84.10
Lead (Pb content)	330,200	2.39	63.38	83.49
Molybdenum (MoS_2 content)	19,200	.24	47.30	87.47
Nickel (Ni content)	32,800	1.52	6.29	87.81
Tin (Sn content)	43,800	.47	44.48	64.47
Tungsten (WO_3 content)	32,040	.29	69.29	83.27
Zinc (Zn content)	758,100	4.46	50.33	NA

NA Not available.

TABLE 4

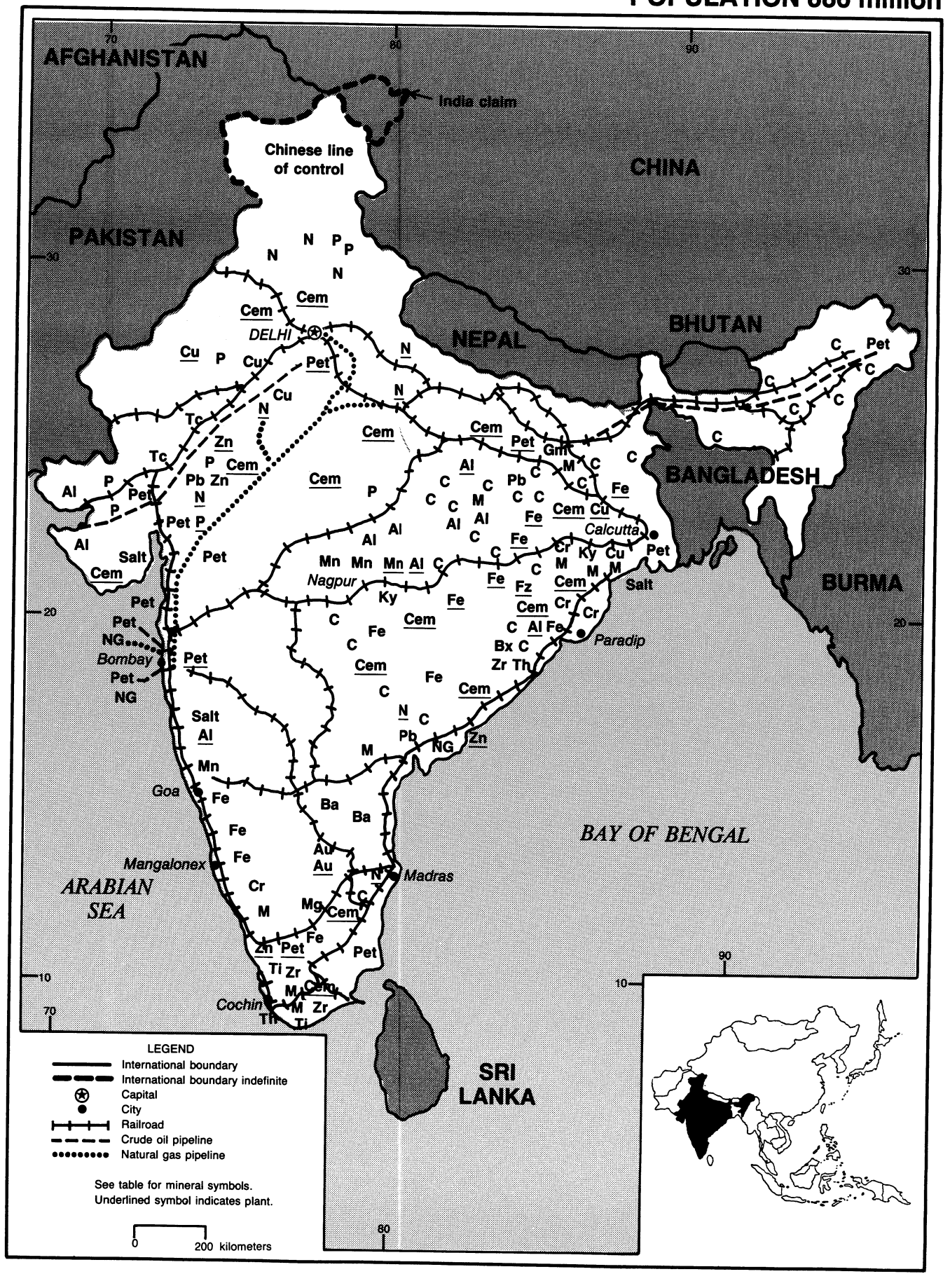
CHINA: SALIENT STATISTICS FOR SELECT IRON ORE PRODUCTION, PIG IRON PRODUCTION, AND CRUDE STEEL PRODUCTION IN 1992

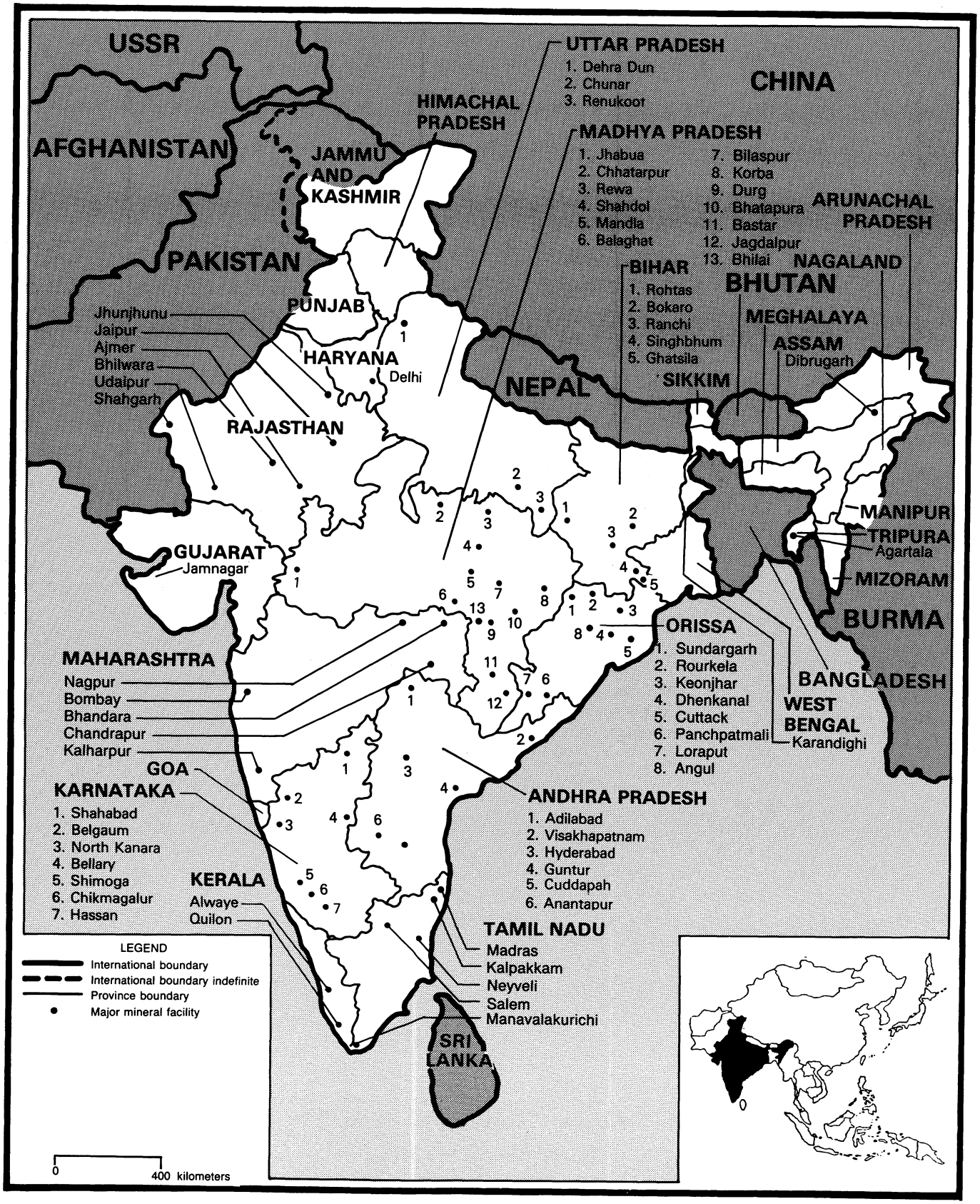
Company (location)	Known completion and/or starting up time	Pig iron output	Steel output	Continuous casting (percent)	Iron ore (thousand tons)	Open cast mine ore grade	Underground mine ore grade	Concentrate grade
		(thousands tons)				(percent)		
Anshan Iron and Steel Co. (Liaoning)	1916	8,080.4	8,393.4	22.2	26,317.9	31.05	33.74	64.10
Baotou Iron and Steel Co. (Nei Mongol)	1958	2,704.6	2,767.4	NA	8,175.7	34.30	NA	61.33
Benxi Iron and Steel Co. (Liaoning)	1905	2,987.5	2,489.1	NA	12,604.0	29.53	NA	67.38
Chongqing Iron and Steel Co. (Sichuan)	1940	1,143.6	843.2	42.8	437.0	37.05	NA	52.99
Jiuquan Iron and Steel Co. (Gansu)	1970	970.7	535.2	56.7	3,692.0	NA	33.43	52.68
Ma'anshan Iron and Steel Co. (Anhui)	1909	2,347.3	2,035.8	24.3	7,498.1	29.82	32.28	62.56
Panzhihua Iron and Steel Co. (Sichuan)	1970	2,818.3	2,369.8	NA	11,252.0	30.95	NA	51.55
Shanghai Baoshan Iron and Steel Complex (Shanghai)	1985	6,226.4	6,507.3	57.1	NA	NA	NA	NA
Shanghai Iron and Steel Works (Shanghai)	—	780.4	5,523.0	52.6	NA	NA	NA	NA
Shanghai Meishan Metallurgical Co. (Shanghai)	1969	1,673.0	4.4	NA	1,843.6	NA	45.19	52.94
Shoudu Iron and Steel Co. (Beijing)	1920	4,343.2	5,702.9	48.4	19,335.8	26.13	NA	68.35
Taiyuan Iron and Steel Co. (Shanxi)	1939	1,542.9	1,916.4	15.8	3,701.6	27.07	NA	64.69
Tangshan Iron and Steel Co. (Hebei)	1944	1,212.9	1,726.3	53.5	2,855.5	30.05	NA	67.01
Tianjin Steel Rolling Mills (Tianjin)	—	1,622.0	1,745.3	43.9	NA	NA	NA	NA
Wuhan Iron and Steel Co. (Hubei)	1958	5,061.4	4,958.9	41.8	4,896.3	42.51	36.21	62.00
Xuanhua Iron and Steel Co. (Hebei)	1978	1,298.8	246.4	NA	590.8	31.53	38.92	62.73

NA Not available.

INDIA

AREA 3.29 million km² **POPULATION 886 million**





LOCATION OF MAJOR MINERAL FACILITIES

THE MINERAL INDUSTRY OF

INDIA

By Travis Q. Lyday

India is a republic consisting of 25 States and 7 union territories. It is endowed with a large work force, including persons skilled in all areas of the minerals industry.

Under India's Constitution, the exploration and production of most minerals fall within the jurisdiction of the central Government. Accordingly, the mineral industry of India primarily is owned and administered by the Government, either directly or through public-sector endeavors, and most mining companies are nationalized.

The country is fairly rich in minerals. Its deposits of bauxite, copper, iron ore, and manganese are some of the largest in the world. Most of these deposits are in the south and central highlands of the country. The total value of all minerals produced in India represented about 3% of the country's gross domestic product that is estimated to be about $252 billion[1] in Indian Fiscal Year (IFY) 1993-94.[2]

India is a major minerals producer, ranking among the world's leading producers of bauxite, bituminous coal, iron ore, and mined zinc. Its main mining industry was the production of coal for power generation. Coal provided an estimated 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 and the balance was 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.

Limestone for steel and cement production remained the leader in the industrial minerals sector, producing an estimated 70% of the total value of industrial minerals.

GOVERNMENT POLICIES AND PROGRAMS

Mining in India was 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. The States can issue mining licenses, but licenses for 30 minerals and metals on a prescribed list, including rare earths, base and precious metals, and coal, can be issued only with approval by the central Government. Mining royalties and taxes, although set and revised by the central Government, are paid directly to the individual States.

The mining industry was administered by the Ministry of Mines, which was responsible for geological surveys, exploration, and administration of the Mines Act for all minerals except the mineral fuels, which included all grades of coal, petroleum and natural gas, and nuclear materials. Coal was administered by the Department of Coal within the Ministry of Energy. The Ministry of Petroleum and Natural Gas was empowered with the responsibility for exploration and production of oil and natural gas, as well as refining, distribution, and marketing. Nuclear materials were regulated by the Department of Atomic Energy (DAE). The Geological Survey of India, the Indian Bureau of Mines, and the Controller of Mining Leases were subordinate offices within the Ministry of Mines.

In March, the central Government proposed a national minerals policy that was intended to attract private and multinational investors into the Indian minerals scene. Under the proposal, foreign investors would be allowed up to 50% equity, or more on a case-by-case basis, in mineral projects, an increase from the previous ceiling of 40%, and restrictions on private investment would be removed for 13 mineral commodities previously reserved exclusively for the State sector. The mineral commodities proposed for removal were chromium, copper, diamond, gold, iron ore, lead, manganese, molybdenum, nickel, platinum-group metals, sulfur, tungsten, and zinc. The coal industry was being deregulated, and more than 100 projects have been identified for development during the eighth 5-year planning period (1992-97) to produce 308 Mmt/a. However, the national Parliament had not approved the proposed policy, and existing minerals legislation was not amended by yearend.

ENVIRONMENTAL ISSUES

Environmental protection in India was specifically legislated under the Mines and Minerals (Regulation and Development) Act, 1957, as modified by subsequent amendments. In addition, there were four main environmental acts relating to control of the mining industry, including the Water (Prevention and Control of Pollution) Act of 1974; Forest Conservation Act of 1980; Air (Prevention and Control of Pollution) Act of 1981; and Environmental Protection Act of 1986, all having ensuing amendments.

Mining lease applications have to contain an environmental management

plan within the mining plan that must be approved by the central Government prior to a State Government issuing a mining license. The environmental management plan has to have an assessment of the impact of the proposed operation, plus methods for remediating and restoring any adversity. These requirements apply to both private- and public-sector endeavors.

PRODUCTION

The total value of mineral production, excluding nuclear materials, was about $7.9 billion in IFY 1993-94, an increase of about 9% over that of the previous IFY. Mineral fuels accounted for about 84% of the total, followed by metallic minerals, 7%, and industrial minerals, 9%.

Maharashtra led the individual States by contributing 28% of the total value of mineral production, followed by Bihar, 14%; Madhya Pradesh, 12%; Gujarat, 9%; Assam, 7%; Andhra Pradesh, 6%; and the remaining States combined, 24%. *(See table 1.)*

TRADE

The estimated value of mineral exports during IFY 1991-92, the latest period for which official data were available, was $3.4 billion.[3] Cut and polished diamond remained India's single largest mineral commodity export, accounting for about 69% of total mineral exports during IFY 1991-92, followed by alumina, emerald, and iron ore, which together accounted for about 20%. Other important mineral exports were chromite, precious and semiprecious gemstone, and dimension stone.

The value of mineral imports during IFY 1991-92 was estimated to be $6 billion, with crude petroleum accounting for about 53%, followed by rough diamond, 32%. Coal, phosphate rock, and sulfur were other important mineral imports during IFY 1991-92.

STRUCTURE OF THE MINERAL INDUSTRY

The minerals industry of India produced about 70 mineral commodities embracing various ores, metals, industrial minerals, and mineral fuels. There were an estimated 4,400 mines operating 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.

Employment in the minerals industry was estimated to exceed 1 million, or about 4.5% of the employed labor force, with the public sector employing about 90% of the total. *(See table 2.)*

COMMODITY REVIEW

Metals

Bauxite, Alumina, and Aluminum.—India has a sizable integrated aluminum industry based on domestic bauxite deposits, which are estimated to comprise about 10% of the world's total. Aluminum remained the sole nonferrous metal for which India had an adequate raw material base.

Indian Aluminium Co. (INDAL), 40% owned by Canada's Alcan Aluminium Ltd., was planning to construct a 1-Mmt/a export-oriented alumina refinery at Bhubaneshwar, Orissa State. The plant was to be managed by Utkal Aluminium International, a joint venture comprised of INDAL, Tata Industries, and Norway's Norsk Hydro AS. It was projected to cost about $700 million. Gujarat Alkalies and Chemicals also was planning a 500,000-mt/a alumina refinery in Gujarat State that was to use bauxite from the State's Kutch District. The Gujarat Mineral Development Corp. was to set up the project.

INDAL successfully completed in midyear the expansion of its 180,000-mt/a Belgaum alumina refinery in Karnataka State to 220,000 mt/a at a cost of about $6.5 million.

National Aluminium Co. (NALCO), the largest integrated aluminum plant in Asia, planned to increase its smelting capacity at Angul (Talchur), Orissa State, from 218,000 mt/a to 345,000 mt/a. NALCO also was proposing to expand its bauxite mines from a capacity of about 2.4 Mmt/a to 4.8 Mmt/a and the alumina refinery from an 800,000-mt/a capacity to one of 1.35 Mmt/a. NALCO's captive powerplant, with a capacity of 600 MW, was being expanded with the addition of 120 MW.

Chromium.—More than one-half of India's chrome ore mines are in the districts of Cuttack, Dhenkanal, and Keonjhar in Orissa State, while the others are distributed relatively evenly among the States of Andhra Pradesh, Bihar, Karnataka, Maharashtra, and Manipur. The major chromite mining companies were Tata Iron and Steel Co. Ltd. (TISCO), Orissa Mining Corp. Ltd., Ferro Alloys Corp. Ltd., Mysore Minerals Ltd., and Indian Metals and Ferro Alloys Ltd.

TISCO commissioned early in the year a lump chrome ore processing plant at its Sukinda Mines in the Cuttack District for about $530,000. The facility's throughput of 200,000 mt/a was of low-grade, hard, lumpy ores, which previously had little commercial value.

Orissa Mining began production at its chromite ore beneficiation plant at its Kaliapani mine site in Cuttack District. The plant was to produce about 84,000 mt/a of concentrate from about 100,000 mt/a of chromite ore.

India's major ferrochrome producers were Ferro Alloys Corp., Visvesvaraya Iron and Steel Ltd., and Indian Development Corp.

Copper.—All of India's mined copper was produced by State-owned Hindustan Copper Ltd. (HCL), which also operated the country's three smelters and two refineries. More than 90% of India's copper ore reserves are in the three states of Bihar, Madhya Pradesh, and Rajasthan.

HCL was planning to more than triple

the capacity, to 100,000 mt/a, at its 31,000-mt/a Khetri smelter in Jhunjhunu, Rajasthan State. As part of the plan, HCL was preparing to decommission two of its high-cost mines, but expand production at three other mines, in Bihar State, as well as develop a new mine at the existing Khetri Mine site in Rajasthan. The project was being implemented in an effort to eliminate some of the marginal economics of its high-cost mining operations by expanding its more lucrative smelting-refining operations. HCL was planning to use imported concentrates.

Bombay-based Sterlite Industries Ltd. began construction early in the year on its 60,000-mt/a smelter and refinery on a greenfield site at Ratnagiri, on the coast of Maharashtra State about 350 km south of Bombay. Projected capacity at the complex was planned to be expanded incrementally to 100,000 mt/a. Commissioning and trial runs were scheduled to begin in March 1995, with commercial production beginning by July of that year. Upon completion, the smelter-refinery complex will be the largest in the country, as well as the first in the private sector. It will use smelter and refining technology provided by Australia's MIM Holdings Ltd.'s ISA-SMELT and ISA-REFINE smelting and refining processes. However, Sterlite continued to be hampered during the year by local environmental groups, with one local village council refusing even to allow Sterlite from using land granted to it by the Maharashtra Industrial Development Corp., and the project was stalled at yearend.

Gold.—Although India is one of the world's largest consumers of gold, spurred by the Government's 1992 decision to permit nonresident Indians to bring into the country up to 5 kg of gold per person for a nominal duty of Rs22/g, domestic production has waned profoundly in recent years, and the country only produces about 2 mt/a. About one-half is produced by the activities of numerous small-scale miners, mainly unorganized independent prospectors.

Government-owned Bharat Gold Mines Ltd. mined gold from a number of mines in the Kolar Gold Fields, Karnataka State, one of the oldest gold mining areas in the world. Modern production from the Kolar Fields began in 1882. A small amount of gold also was produced as a byproduct of copper refining.

Iron and Steel.—India is a major producer of iron ore, which is 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. There are numerous iron ore mines in the country with an estimated combined capacity of 50 Mmt/a.

The country has abundant deposits of hematite and magnetite iron ores. Hematite occurs mostly in the States of Bihar, Goa, Karnataka, Madhya Pradesh, Maharashtra, and Orissa. Magnetite deposits, most of them of metallurgical grade, occur in Andhra Pradesh, Goa, Karnataka, and Kerala States. Goa was the leading producing State, replacing Madhya Pradesh.

NMDC operated the country's largest iron mines at Bailadila, Madhya Pradesh State, and at Donimalai, Karnataka State. Output from the two mines was about 9 Mmt/a, but output was planned to be doubled by IFY 1996-97.

The country has seven integrated steel plants (ISP) and numerous scrap-based minimills with a combined capacity of about 23 Mmt/a. The Government's Steel Authority of India Ltd. (SAIL) manages five ISP, namely Bhilai ISP, Madhya Pradesh State; Bokaro ISP, Bihar State; Durgapur ISP, West Bengal State; Rourkela ISP, Orissa State; and Burnpur ISP, West Bengal State, the steelworks operated by Indian Iron and Steel Co. Ltd., a wholly owned subsidiary of SAIL since 1979. The Visakhapatnam ISP, Andhra Pradesh State, owned and operated by the public-sector corporation Rashtriya Ispat Nigam Ltd., was commissioned near yearend 1989. The only privately owned ISP in India, the steelworks at Jamshedpur, Bihar State, is operated by TISCO.

Grasim Industries commissioned in March a 750,000-mt/a direct-reduced-iron (DRI) plant near Alibag, about 130 km south of Bombay, Maharashtra State. The Alibag facility, the country's second natural gas-based DRI plant, increased Indian DRI capacity by more than 35%. India's first natural gas-based DRI plant was Essar Gujarat Ltd.'s 1.3-Mmt/a works at Hazira on the west coast of Gujarat State. Both DRI works use gas from the Bombay High offshore gasfield. India has eight other DRI plants that are fueled using coal.

Lead and Zinc.—Substantial quantities of lead and zinc are produced from the same mines in the State of Rajasthan by Hindustan Zinc Ltd. (HZL), a State-owned corporation and the country's sole producer of both metals. HZL also mines 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., producing zinc from imported concentrates.

The private-sector Indian Lead Ltd. produced secondary lead from indigenous and imported lead scrap and lead concentrates from plants at Phane, Maharashtra State, and at Kalipara, West Bengal State.

India became self-sufficient in the production of lead and zinc following HZL's commissioning of its Rampura-Agucha Mine and Chanderiya Smelter-Refinery in Rajasthan in May 1991.

Uranium.—The Atomic Minerals Div. (AMD) within DAE is entrusted with conducting radiometric and geological surveys and the exploration and development of various mineral resources necessary for the country's nuclear power program. During IFY 1993-94 AMD completed its exploratory mining program at Tummalapalle, Andhra Pradesh State, and commenced an experimental mining program at Jajawal, Madhya Pradesh.

The Uranium Corp. of India Ltd. (UCIL) within the DAE operates uranium mines at Jaduguda and Bhatin; a uranium

mill at Jaduguda; and uranium recovery plants at Mosaboni, Rakha, and Surda, all in Bihar State. UCIL also has the capability of recovering other metals/minerals as byproducts, such as copper, magnetite, and molybdenite.

Industrial Minerals

Diamond.—The Government-owned NMDC produced most of the country's modest diamond output from its diamondiferous kimberlite mines at Wajrakarur, Andhra Pradesh. A small quantity of diamond also was produced in Orissa State.

India's diamond industry, the world's largest in terms of employment, quantity, and value, primarily was dependent on imported materials for processing and reexport. India processes an estimated 65% of the world's rough diamonds and has about 45% of the world trade in finished diamonds. The majority of the cutting and polishing plants are in Bombay, Maharashtra State, and Surat, Gujarat State.

Mineral Fuels

Coal.—Coal was India's principal energy source, producing an estimated 60% of the country's requirements. Coal mining in the private sector was permitted only for captive consumption. The Government-owned Coal India Ltd. was the country's largest producer. The coking properties of Indian coals are poor because they have a very high ash content; therefore, metallurgical-grade coals are imported, primarily from Australia.

About 80% of the country's known lignite occurs in Tamil Nadu State, with deposits also known in the States of Gujarat, Kerala, Rajasthan, and Jammu and Kashmir. The central Government-owned Neyveli Lignite Corp. was the country's sole producer.

Petroleum and Natural Gas.—The central Government of India administers the petroleum and natural gas industry of the country from exploration to the marketing of refined petroleum products. Two companies, Oil and Natural Gas Corp. Ltd., formerly Oil and Natural Gas Commission, and Oil India Ltd., conduct exploration for hydrocarbons and develop suitable discoveries for production. Six Government-owned companies operate the country's petroleum refineries. Imports and exports of crude oil and refined petroleum products are managed by Indian Oil Corp., the largest of the refining companies.

The Government began permitting in September foreign and private domestic companies to conduct, under risk contracts, seismic and other surveys of unexplored sedimentary basins to upgrade available information on the country's petroleum resources. The first round offered 21 offshore and 14 onshore blocks spread over an area of 820,000 km^2.

Reserves

The country's mineral resources have not been fully delineated, and large deposits of bauxite, coal, iron ore, limestone, and oil and gas still are likely to be found in many areas. Bauxite deposits mainly are in the States of Andhra Pradesh and Orissa, but also occur in Bihar, Gujarat, Maharashtra, and Tamil Nadu. Iron ore deposits, mainly in the form of hematite or magnetite, occur in Bihar, Karnataka, Madhya Pradesh, Orissa, and Tamil Nadu States. Low-grade copper deposits are in Andhra Pradesh, Bihar, Madhya Pradesh, and Rajasthan. Lead and zinc deposits mainly are in Bihar and Rajasthan. Chromium and nickel ore reserves exist in Orissa. Diamond is produced in Madhya Pradesh, and gold is mined in small amounts in Karnataka. The Ilmenite sands at the extreme southern tip of India in Kerala and Tamil Nadu States contain large amounts of thorium. *(See table 3.)*

INFRASTRUCTURE

Just about all modes, including aerial ropeways, are used for mineral transport in India. Over short distances, aerial ropeways are used in preference to conveyor belts, which are used over stretches of uneven terrain at mining operations.

The Indian road network, one of the largest in the world, consists of 1,970,000 km of roads, including 960,000 km that are paved and 1,010,000 km that are comprised of gravel, crushed stone, or unimproved earth.

Inland waterways, of which there was 16,180 km usable by all craft and 3,631 km navigable by large vessels, were of little importance to the minerals industry. Sea transport, however, was the only method used for importing and exporting minerals to and from the country's ports, which included Bombay, Calcutta, Cochin, Kandla, Madras, and Mangalore, and Port Blair in the Andaman and Nicobar Islands Territory. The merchant marine fleet included 114 bulk ore freighters; 63 petroleum, oils, and lubricant tankers; 10 chemical tankers; 8 combination ore-oil tankers; 6 liquefied gas tankers; and 2 combination bulk ore freighters.

The Indian railway system, Asia's largest and the world's fourth largest, consists of 61,850 km of track, 33,553 km of which was 1.676-m broad gauge, 24,051 km 1.000-m gauge, and 4,246 km 0.762-m or 0.610-m narrow gauge. Included in the total was 6,500 km of electrified rail. The mixed gauges of track created difficulties, such as loss of time in transshipment and the requirement for multiple stocking of spare parts. In addition, the rail system has a profusion of obsolete equipment that is unreliable and expensive to maintain.

There were 205 principal airports with permanent-surface runways out of an aggregate of 285 in the country.

Pipelines included 3,497 km for crude oil; 1,703 km for refined oil products; and 902 km for natural gas.

Electric generating capacity in 1992 was 82 GW. 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 power by year 2000. Total production of electrical power in 1992 was 310 billion kW • h.[4]

OUTLOOK

With the country continuing to exhibit indications of political stability, the Government's introduction in the past 3 years of reforms in an attempt to open up the country's economy, and the proposal in 1993 of a national minerals policy to attract new foreign investment, India seems to be progressing, albeit slowly considering its potential, toward minerals self-sufficiency.

Enactment by Parliament of a national minerals policy, which was expected to occur early in 1994, will open mineral extraction to the private sector, except for mineral fuels and nuclear materials. This, along with the relaxation of restrictions on foreign equity participation in the minerals industry, will enable broader participation in exploration and development of mineral leases that formerly were reserved exclusively for the Government. This additional expertise in mineral exploration will enable the country to locate and assess its vast mineral resources more consistently and efficiently.

[1]Where necessary, values have been converted from Indian rupees (Rs) to U.S. dollars at the rate of Rs31.25=US$1.00 during Indian Fiscal Year 1993-94.

[2]The Indian Fiscal Year begins on April 1 and ends on March 31.

[3]Where necessary, values have been converted from Indian rupees (Rs) to U.S. dollars at the rate of Rs24.52=US$1.00 during Indian Fiscal Year 1991-92.

[4]U.S. Central Intelligence Agency, Washington, DC: The World Factbook 1993, pp. 181-182.

OTHER SOURCES OF INFORMATION

Agencies

Geological Survey of India
27 Jawaharlal Nehru Road
Calcutta 700 016, India
Telephone: +91 33 2496976
Fax: +91 33 2496956

Indian Bureau of Mines
New Secretariat Building
Nagpur 440 001, India
Telephone: +91 712 534642, 523934
Fax: +91 712 533041

National Mineral Development Corp. Ltd. (NMDC)
'Khanij Bhawan, 10-3-311/A, Castle Hills
Masab Tank, Hyderabad 500 028, India
Telephone: +91 40 222071, 222072
Fax: +91 40 222236

Oil and Natural Gas Corp. Ltd., formerly Oil and Natural Gas Commission
Bombay Offshore Project
12 Floor, Express Towers, Nariman Point
Bombay 400 021, India
Telephone: +91 22 2026446, 2022559
Fax: +91 22 2027938

Oil India Limited
Allahabad Bank Building
17 Parliament Street
New Delhi 110 001, India
Telephone: +91 11 310841, 310844, 310675
Fax: +91 11 310962

Publications

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

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TABLE 1

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992e	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Aluminum:							
Bauxite, gross weight	thousand tons	r4,471	4,852	r4,735	r4,898	35,223	5,200
Alumina, Al_2O_3 equivalent	do.	1,947	1,601	1,700	1,700	1,800	2,200
Metal, primary		423,400	433,270	r504,000	490,000	435,000	510,000
Cadmium metal		275	277	207	210	220	290
Chromium: Chromite, gross weight		1,002,659	939,000	994,674	1,000,000	31,084,020	1,100,000
Copper:							
Mine output, Cu content		57,376	e58,200	55,380	55,000	58,200	60,000
Metal, primary:							
Smelter		42,456	40,667	47,000	50,000	43,300	52,000
Refinery:							
Electrolytic (cathode)		41,041	40,598	45,000	45,000	35,000	43,000
Fire refined		802	e1,000	e1,000	1,000	500	2,000
Total		41,843	e41,598	46,000	46,000	35,500	45,000
Gold metal, smelter	kilograms	1,827	1,983	r1,973	2,000	1,875	2,200
Iron and steel:							
Iron ore and concentrate:							
Gross weight	thousand tons	53,418	54,579	r57,638	54,000	61,000	81,000
Iron content	do.	33,440	34,200	35,600	33,800	38,200	XX
Metal:							
Pig iron	do.	12,080	12,645	14,176	15,000	15,400	16,000
Direct-reduced iron	do.	340	750	1,180	31,440	2,200	2,200
Ferroalloys:							
Ferrochromium (including charge chrome)		135,000	122,000	r96,007	95,000	160,000	215,000
Ferromanganese		157,776	201,194	r e211,000	r198,000	150,000	170,000
Ferrochromium-silicon		11,384	7,000	8,800	9,000	8,000	12,000
Ferrosilicon		74,472	64,035	r39,099	39,000	53,000	75,000
Silicomanganese		72,229	57,361	r e70,000	r93,000	80,000	75,000
Silicon metal		—	—	—	—	—	—
Other		386	e400	r6,767	6,500	7,500	170,000
Steel, crude:							
Steel ingots	thousand tons	r14,278	r14,613	r16,700	r 317,667	15,400	18,000
Steel castings e	do.	3330	350	400	450	3,100	3,200
Total e	do.	r 314,608	r14,963	r17,100	r18,117	18,500	21,200
Semimanufactures e 4	do.	39,241	10,500	11,600	12,000	9,000	12,000
Lead:							
Mine output, Pb content		24,300	23,220	r25,068	25,000	40,000	50,000
Metal, refined:							
Primary		21,260	r29,919	e33,140	30,000	20,000	32,000
Secondary		13,469	r16,808	e20,260	20,000	13,000	22,000
Total		34,729	r46,727	e53,400	50,000	33,000	54,000
Manganese:							
Ore and concentrate, gross weight	thousand tons	1,334	1,385	1,401	1,400	1,750	4,000
Mn content		496,861	r525,000	r532,000	530,000	660,000	XX
Rare-earth metals: Monazite concentrate, gross weight e		4,300	4,500	4,000	4,000	4,600	5,500

See footnotes at end of table.

TABLE 1—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992e	1993e	Annual capacity e (Jan. 1, 1994)
METALS—Continued							
Selenium	kilograms	4,261	3,840	r e4,000	4,000	6,000	6,500
Silver, mine and smelter output	do.	35,499	33,206	r31,758	32,000	35,000	39,000
Titanium concentrates, gross weight:							
Ilmenite		240,656	e280,000	311,537	300,000	320,000	340,000
Rutile		9,931	e11,000	13,635	10,000	13,900	14,800
Tungsten, mine output, W content		12	e10	11	11	3	15
Zinc:							
Mine output, concentrate:							
Gross weight		127,043	137,649	163,474	170,000	200,000	350,000
Zn content		65,384	73,970	r75,000	75,000	104,000	XX
Metal:							
Primary		71,572	79,093	r85,800	80,000	115,000	135,000
Secondary e		200	200	200	200	200	250
Total e		71,772	79,293	r86,000	80,200	115,200	135,250
Zirconium concentrate: Zircon, gross weight e		17,200	17,500	r18,200	18,000	20,000	25,000
INDUSTRIAL MINERALS							
Abrasives, natural, n.e.s.:							
Corundum, natural		254	410	64	70	10	260
Garnet		5,652	4,422	8,984	9,000	15,000	25,000
Jasper		r5,297	e4,650	5,013	5,000	7,000	8,000
Asbestos		r36,502	26,053	r24,094	25,000	37,000	40,000
Barite		r548,103	633,000	615,000	620,000	400,000	700,000
Bromine, elemental e		r1,272	1,300	1,300	1,300	1,400	1,500
Cement, hydraulic	thousand tons	r46,000	49,000	51,000	50,000	52,000	54,000
Chalk		119,000	128,000	128,424	129,000	120,000	140,000
Clays:							
Ball clay		266,000	245,000	316,522	320,000	440,000	460,000
Diaspore		15,301	7,701	9,248	9,300	12,500	17,000
Fire clay		618,000	r522,000	r403,000	410,000	530,000	650,000
Kaolin:							
Direct salable, crude	thousand tons	520	r631	r628	625	650	665
Processed	do.	110	104	113	110	150	160
Total	do.	630	r735	r741	735	800	825
Other e	do.	100	100	14	15	110	330
Diamond: e							
Gem	thousand carats	12	15	r15	15	16	16
Industrial	do.	3	3	3	3	3	4
Total	do.	15	18	r18	18	19	20
Feldspar		r59,690	54,135	65,089	65,000	70,000	72,000
Fluorspar:							
Concentrates:							
Acid-grade		10,300	10,399	9,700	10,000	10,500	12,000
Metallurgical-grade		12,589	13,042	14,439	15,000	9,500	15,000
Total		22,889	23,441	24,139	25,000	20,000	27,000
Other fluorspar materials, graded		5,176	r5,715	r8,218	9,000	9,000	10,000

See footnotes at end of table.

TABLE 1—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992e	1993e	Annual capacity e (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Gemstones excluding diamond:							
Agate including chalcedony pebble		788	631	549	600	650	800
Garnet	kilograms	2,483	2,005	1,187	1,400	1,000	2,500
Graphite[5]		58,000	61,000	69,922	70,000	64,000	75,000
Gypsum		1,564,000	r1,661,000	r1,553,000	1,550,000	1,900,000	2,000,000
Kyanite and related materials:							
Kyanite		40,009	r38,851	r30,020	31,000	12,000	42,000
Sillimanite		17,398	r18,240	11,600	12,000	15,000	20,000
Lime e		790,000	800,000	820,000	850,000	860,000	900,000
Magnesite		491,000	544,000	r539,000	550,000	500,000	600,000
Mica:[6]							
Crude		4,195	3,860	3,607	3,500	3,000	4,500
Scrap and waste		3,108	2,822	1,922	2,000	1,600	3,500
Total		7,303	6,682	5,529	5,500	4,600	8,000
Nitrogen: N content of ammonia[7]	thousand tons	6,661	r7,010	r7,132	r 37,452	7,354	7,500
Phosphate rock including apatite		703,716	r674,000	562,771	600,000	635,000	725,000
Pigments, mineral: Natural: Ocher		173,366	126,387	155,563	160,000	175,000	180,000
Pyrites, gross weight		38,867	r94,000	r128,000	100,000	126,000	130,000
Salt:e							
Rock salt	thousand tons	3 3	3	3	3	2	4
Other	do.	9,600	9,500	9,500	9,500	9,500	9,600
Total	do.	9,603	9,503	9,503	9,503	9,502	9,604
Sodium carbonate		1,343,500	e1,400,000	e1,500,000	1,500,000	1,500,000	1,600,000
Stone, sand and gravel:[8]							
Calcite		40,326	55,000	r98,236	100,000	800,000	110,000
Dolomite	thousand tons	2,417	r2,621	r2,568	2,500	3,800	4,000
Limestone	do.	64,032	r67,236	r71,021	70,000	85,000	88,000
Quartz and quartzite	do.	326	285	251	250	260	335
Sand:							
Calcareous	do.	106	r218	r117	120	215	225
Silica	do.	1,239	1,139	1,924	2,000	1,100	2,000
Other	do.	1,242	e1,300	1,652	1,700	2,400	2,500
Slate		25,963	r30,563	23,578	24,000	3,715	4,725
Sulfur:							
Content of pyrites		38,867	r94,000	r128,000	100,000	55,000	140,000
Byproduct:							
From metallurgical plants e		125,000	125,000	130,000	130,000	130,000	135,000
From oil refineries		10,200	10,315	12,261	13,000	13,500	14,000
Total e		174,067	r229,315	r270,261	243,000	198,500	289,000
Talc and related materials:							
Pyrophyllite		93,000	80,000	84,557	85,000	82,000	100,000
Steatite (soapstone)		414,286	r406,000	r424,000	425,000	390,000	430,000
Vermiculite		3,075	1,769	1,768	2,000	1,600	3,500
Wollastonite		44,042	61,386	61,358	62,000	44,000	70,000

See footnotes at end of table.

TABLE 1—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992e	1993e	Annual capacity e (Jan. 1, 1994)
MINERAL FUELS AND RELATED MATERIALS							
Coal:							
Bituminous	thousand tons	r200,890	r211,730	r229,280	210,000	220,000	240,000
Lignite	do.	r12,640	r14,110	r15,970	15,000	15,000	17,000
Total	do.	r213,530	r225,840	r245,250	225,000	235,000	257,000
Coke:e							
Coke oven and beehive	do.	13,000	13,000	13,000	13,000	13,000	14,000
Gashouse	do.	100	100	100	100	100	120
Other, soft	do.	200	200	200	200	200	220
Total	do.	13,300	13,300	13,300	13,300	13,300	14,340
Gas, natural:							
Gross	million cubic meters	10,490	10,240	r11,532	11,600	13,000	13,000
Marketable[9]	do.	6,700	e6,560	e7,500	7,500	10,900	14,500
Petroleum:							
Crude	thousand 42-gallon barrels	250,700	227,800	232,900	235,000	190,000	190,000
Refinery products:e							
Liquefied petroleum gas	do.	20,500	20,000	20,000	20,000	20,000	XX
Gasoline	do.	23,200	23,000	23,000	23,000	23,000	XX
Kerosene and jet fuel	do.	54,000	53,000	53,000	53,000	53,000	XX
Distillate fuel oil	do.	123,000	122,000	122,000	122,000	122,000	XX
Residual fuel oil	do.	57,200	56,000	56,000	56,000	56,000	XX
Lubricants	do.	4,100	4,000	4,000	4,000	4,000	XX
Other	do.	68,000	67,000	67,000	67,000	67,000	XX
Total	do.	350,000	345,000	345,000	345,000	345,000	350,000

eEstimated. rRevised. XX Not applicable.

[1]Table includes data available through June 30, 1994.

[2]In addition to commodities listed, other clays (bentonite, common clays, and fuller's earth), other gemstones (aquamarine, emerald, ruby, and spinel), and uranium are produced but output is not reported, and available information is inadequate to make reliable estimates of output levels. Reported production of sand and gravel and stone are clearly only partial figures and exclude a number of types of stone; the amounts reported are inadequate to provide sufficient aggregate for production of concrete from domestically produced and consumed cement, nor do they provide for other supplies of aggregate for road metal and other construction uses.

[3]Reported figure.

[4]Excludes production from steel miniplants.

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

[6]The disparity between amounts of mica produced versus amounts exported is based on (a) stockpile, (b) illicit mines, and (c) occasional mining by others seeking additions to income nominally derived from other sources.

[7]Data are for fiscal years beginning Apr. 1 of that stated.

[8]Partial figures; for details, see footnote 2.

[9]Includes reinjected gas.

TABLE 2

INDIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
Aluminum:			
Bauxite	Bharat Aluminium Co. Ltd., Government	Manla, Madhya Pradesh	200
Do.	do.	Bilaspur, Madhya Pradesh	600
Do.	Bombay Mineral Supply Co. (Pvt.) Ltd.	Jamnagar, Gujarat	150
Do.	Hindustan Aluminium Co. Ltd., private	Ranchi, Bihar	300
Do.	do.	Shandol, Madhya Pradesh	300
Do.	Indian Aluminium Co. Ltd.	Kalharpur, Maharashtra	250
Do.	do.	Ranchi, Bihar	250
Do.	Madras Aluminium Co. Ltd.	Salem, Tamil Nadu	150
Do.	Minerals & Minerals Ltd.	Ranchi, Bihar	200
Do.	National Aluminium Co. Ltd., Government	Panchpatmali, Orissa	2,400
Metal	Bharat Aluminium Co. Ltd.	Korba, Madhya Pradesh	100
Do.	Hindalco Aluminium Co. Ltd.	Renukoot, Uttar Pradesh	150
Do.	Indian Aluminium Co. Ltd.	Alipuram, Kerala	20
Do.	do.	Belgaum, Karnataka	73
Do.	do.	Hirakud, Orissa	24
Do.	Madras Aluminium Co. Ltd.	Metturdam, Tamil Nadu	25
Do.	National Aluminium Co. Ltd.	Angul, Dhenkanal District, Orissa	218
Barite	Andhra Pradesh Mining Corp. Ltd.	Mangampet, Cuddapah District, Andhra Pradesh	350
Do.	C.M. Ramanatha Reddy	Kodur, Anantapur District, Andhra Pradesh	75
Do.	K. Obul Reddy (Pvt.) Ltd.	Cuddapah District, Andhra Pradesh	25
Do.	Pragathi Minerals (Pvt.) Ltd.	Kodur, Anantapur District, Andhra Pradesh	50
Do.	Vijayalaxmi Minerals Trading Co.	do.	50
Cement:			
Public sector	Bihar State Industrial Development Corp.	Rohtas-Palaman, Bihar	760
Do.	Cement Corp. of India Ltd.	Jagdalpur, Madhya Pradesh	1,000
Do.	do.	Tandur, Hyderabad District, Andhra Pradesh	1,000
Do.	do.	Yerraguntia, Cuddapah District, Andhra Pradesh	1,120
Do.	Hindustan Steel Ltd.	Rourkela, Orissa	2,140
Do.	Uttar Pradesh State Cement Corp.	Chunar, Uttar Pradesh	840
Private sector	Associated Cement Co. Ltd.	Shahabad, Karnataka	1,076
Do.	Century Spring & Manufacturing Co.	Chandrapur, Maharashtra	1,000
Do.	Coromandel Fertilizers	Kalamalla, Cuddapah District, Andhra Pradesh	1,000
Do.	Jaypee Rewa Cement Ltd.	Rewa, Madhya Pradesh	1,000
Do.	Larsen & Toubro Ltd.	Chandrapur, Maharashtra	1,109
Do.	Modi Cement Ltd.	Bhatapure, Madhya Pradesh	1,000
Do.	Rajasthan Manufacturing & Weaving Mills Ltd.	Bhilwara, Rajasthan	1,042
Do.	Shree Cement Ltd.	Bewar, Ajmer District, Rajasthan	1,200
Chromite	Ferro Alloys Corp. Ltd.	Keonjhar District, Orissa	75
Do.	do.	Dhenkanal District, Orissa	75
Do.	Mysore Minerals Ltd.	Hassan District, Karnataka	125
Do.	Orissa Mining Corp.	Cuttack District, Orissa	200
Do.	do.	Dhenkanal District, Orissa	200
Do.	do.	Keonjhar District, Orissa	100
Do.	Tata Iron & Steel Co. Ltd.	Cuttack District, Orissa	100

See footnotes at end of table.

TABLE 2—Continued

INDIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
Coal:			
Bituminous	Coal India Ltd:[1]		
Do.	Bharat Coking Coal Ltd.	105 mines in Bihar, Orissa, and Uttar Pradesh	
Do.	Eastern Coalfields Ltd.	187 mines in Bihar and West Bengal	
Do.	Northern Coalfields Ltd.	61 mines in Madhya Pradesh and Uttar Pradesh	160,000
Do.	Southeastern Coalfields Ltd.	44 mines in Andhra Pradesh and Orissa	
Do.	Western Coalfields Ltd.	55 mines in Madhya Pradesh, Maharashtra, and Orissa	
Lignite	Neyveli Lignite Corp.	Neyveli, Tamil Nadu	8,000
Copper:			
Ore	Hindustan Copper Ltd.	Khetri copper complex, Jhunjhunu District, Rajasthan:	
Do.	do.	Khetri Mine	
Do.	do.	Kolihan Mine	2,000
Do.	do.	Chandmari Mine	
Do.	do.	Indian copper complex, Singhbhum District, Bihar:	
Do.	do.	Mosabani Mine	
Do.	do.	Pathargora Mine	
Do.	do.	Surda Mine	1,800
Do.	do.	Kendadih Mine	
Do.	do.	Rakha Mine	
Do.	do.	Malanjkhand, Balaghar District, Madhya Pradesh	2,000
Metal	do.	Khetri smelter, Rajasthan	31
Do.	do.	Maubhandar smelter, Ghatsila District, Bihar	20
Iron:			
Ore and concentrate	Chowgule & Co. Pvt. Ltd.	Goa	2,500
Do.	Dempo Mining Corp. Ltd.	do.	2,500
Do.	V.M. Salgaocar & Bros. Pvt. Ltd.	do.	2,500
Do.	Indian Iron & Steel Co. Ltd.	Singhbhum District, Bihar	2,500
Do.	Kudremukh Iron Ore Co. Ltd.	Chikmagalur District, Karnataka	7,500
Do.	National Mineral Development Corp. Ltd.	Bellary District, Karnataka	3,000
Do.	Steel Authority of India Ltd.	Singhbhum District, Bihar	3,500
Do.	do.	Bastar and Durg District, Madhya Pradesh	7,000
Do.	do.	Keonjhar District, Orissa	3,000
Do.	Tata Iron & Steel Co. Ltd.	Singhbhum District, Bihar	3,500
Do.	do.	Keonjhar District, Orissa	2,000
Steel, primary	Steel Authority of India Ltd.	Bhilai steelworks, Madhya Pradesh	4,000
Do.	Steel Authority of India Ltd.	Bokaro steelworks, Bihar	4,000
Do.	Indian Iron and Steel Co. Ltd., wholly owned subsidiary of Steel Authority of India Ltd.	Burnpur steelworks, West Bengal	1,000
Do.	Steel Authority of India Ltd.	Durgapur steelworks, West Bengal	1,600
Do.	Steel Authority of India Ltd.	Rourkela steelworks, Orissa	1,800
Do.	Tata Iron and Steel Co. Ltd.	Jamshedpur steelworks, Bihar	2,500
Do.	Rashtriya Ispat Nigam Ltd.	Visakhpatnam steelworks, Andhra Pradesh	3,400
Do.	Steel Authority of India, Ltd.	Bhilai, Durg District, Madhya Pradesh	2,680
Do.	do.	Bokaro, Bihar	2,230
Do.	Tata Iron & Steel Co. Ltd.	Jamshedpur, Singhbhum District, Bihar	1,740
Do.	159 private ministeel plants	Countrywide	4,700

See footnotes at end of table.

TABLE 2—Continued

INDIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
Kyanite	Hindustan Copper Ltd.	Lapso, Singhbhum District, Bihar	22
Do.	Maharashtra Mineral Corp. Ltd.	Bahegaon, Bhandara District, Maharashtra	10
Do.	Maharashtra State Mining Corp. Ltd.	Bhandara, Maharashtra	10
Do.	S.M. Khola	do.	10
Lead:			
Concentrate	Hindustan Zinc Ltd.	Gunter District, Andhra Pradesh	10
Do.	do.	Udaipur District, Rajasthan	20
Metal, primary	do.	Visakhapatnam, Andhra Pradesh	22
Do.	do.	Tundoo, near Ghatsila, Bihar	8
Magnesite	Burn Standard Co. Ltd.	Salem, Tamil Nadu	150
Do.	Dalmia Magnesite Corp.	do.	150
Do.	Tamil Nadu Magnesite Ltd.	do.	150
Manganese ore[2]	Aryan Mining & Trading Corp.	Sundargarh, Orissa	NA
Do.	Eastern Mining Co.	North Kanara, Karnataka	NA
Do.	J.A. Trivedi Bros.	Balaghat, Madhya Pradesh	NA
Do.	Manganese ore (India) Ltd.	Adilabad, Andhra Pradesh	NA
Do.	do.	Balaghat, Madhya Pradesh	NA
Do.	do.	Bhandara, Maharashtra	NA
Do.	do.	Keonjhar, Orissa	NA
Do.	Mangilah, Rungta (Pvt.) Ltd.	do.	NA
Do.	Mysore Minerals Ltd.	North Kanara, Karnataka	NA
Do.	do.	Shimoga, Karnataka	NA
Do.	Orissa Manganese & Minerals (Pvt.) Ltd.	Sundargarh, Orissa	NA
Do.	Orissa Mineral Development Co. Ltd.	Koraput, Orissa	NA
Do.	Orissa Mining Corp. Ltd.	Keonjhar, Orissa	NA
Do.	do.	Koraput, Orissa	NA
Do.	R.B.S. Shreeram Durga Prasad & Falechand Marsingdas	Vizianagaram, Visakhapatnam District, Andhra Pradesh	NA
Do.	Rungta Mines (Pvt.) Ltd.	Keonjhar, Orissa	NA
Do.	Sandur Manganese & Iron Ores Ltd.	Bellary, Karnataka	NA
Do.	Serajuddin & Co.	Keonjhar, Orissa	NA
Do.	S. Lall & Co.	do.	NA
Do.	Tata Iron & Steel Co. Ltd.	Keonjhar, Orissa	NA
Do.	do.	Sundargarh, Orissa	NA
Phosphate rock[3]	Hindustan Zinc Ltd.	Udaipur District, Rajasthan	NA
Do.	Madhya Pradesh State Mining Corp. Ltd.	Jhabua, Madhya Pradesh	NA
Do.	do.	Chhatarpur, Madhya Pradesh	NA
Do.	Pyrites Phosphates & Chemicals Ltd.	Dehra Dun, Uttar Pradesh	NA
Do.	Rajasthan State Mineral Development Corp. Ltd.	Udaipur District, Rajasthan	NA
Do.	Rajasthan State Mines & Minerals Ltd.	do.	NA
Titanium, ilmenite concentrate	Kerala Minerals & Metals Ltd.	Chavara, Quilon District, Kerala	100
Do.	Indian Rare Earths Ltd.	do.	200
Do.	do.	Ganjam, Orissa, 100 km south of Dhenkanal	220
Do.	do.	Manavalakurichi, Tamil Nadu	65

See footnotes at end of table.

TABLE 2—Continued

INDIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
Zinc:			
Concentrate	Hindustan Zinc Ltd.	Zawar, Udaipur District Rajasthan	34
Do.	do.	Rajpura-Dariba, Udaipur District, Rajasthan	42
Metal	Comindo Binani Zinc Ltd.	Binanipuram, near Alwaye, Kerala	17
Do.	Hindustan Zinc Ltd.	Debari, Udaipur District, Rajasthan	49
Do.	do.	Visakhapatnam, Andhra Pradesh	30

[e]Estimated. NA Not available.

[1]The annual capacity of the five major Coal India subsidiaries was as follows: 14 mines, more than 1 Mmt, for 17% of capacity; 32 mines, 0.5 to 1 Mmt, for 17%; 80 mines, 0.3 to 0.5 Mmt, for 24%; 254 mines, 0.1 to 0.3 Mmt, for 39%; and the remaining mines, less than 0.1 Mmt.

[2]Capacity of clusters of surface mines varies extremely, depending on demand. Estimated total annual capacity is 1.5 Mmt.

[3]Estimated total annual phosphate rock capacity is 0.8 Mmt.

TABLE 3

INDIA: ESTIMATED RESERVES OF MAJOR MINERAL COMMODITIES FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Bauxite		2,333,00
Barite		35,000
Chromite		108,000
Coal:		
Bituminous		186,044,000
Lignite		5,813,000
Copper, in ore		4,000
Gold	kilograms	55,000
Graphite		4,648
Iron, in ore		11,000,000
Kyanite group		15,000
Lead, in ore		160,000
Limestone		60,000,000
Magnesite		222,000
Manganese in ore		154,000
Natural gas	billion cubic meters	648
Petroleum, crude	million metric tons	726
Phosphate rock		102,000
Salt		(1)
Talc and related minerals		15,000
Titanium		62,000
Zinc		7,488
Zircon		1,420

[1]Essentially all from seawater.

INDONESIA

AREA 1,919,440 km² **POPULATION 197.2 million**

THE MINERAL INDUSTRY OF

INDONESIA

By Chin S. Kuo

The country's gross domestic product expanded by 6.2% in 1993, as the Government decided to ease its 2-year-old tight monetary policy. The central bank slashed interest rates on bonds from 13.6% to 7%, commercial bank deposit rates fell from an average of 17% to less than 13%, and interest rates on loans declined from 22% to about 18%. The economic growth also was fueled by a rise in consumer spending and the healthy growth of non-oil exports.

Total exports for 1993 were expected to reach $38.3 billion. Oil and gas exports accounted for 30% of total exports. Oil and gas continued to be important components of the country's economy, earning foreign exchange and providing energy sources. Crude oil production increased over that of 1992, as did crude oil exports. However, oil export revenue fell because of low world prices. The country imported more crude oil in 1993. The Government withdrew domestic oil subsidies in the hope of restricting the growth in oil consumption to 5% per year.

Non-oil exports also grew by 16.5%. Major non-oil export products included textiles and garments, plywood, footwear, electronic goods, processed rubber products, base metals, and seafood products, in descending values.

The decision to remove domestic oil subsidies in early 1993 resulted in a 27% increase in gasoline prices, higher transport costs, and a 13% increase in electricity tariffs. The Government struggled to keep inflation less than 10%. The country's debt-service ratio remained high at 30% of export earnings. Foreign debt burden worsened in 1993 owing to the appreciation of the Japanese yen against the U.S. dollar. A substantial increase in exports resulted in a reduction of the current account deficit to $2.3 billion.

Foreign investment in Indonesia fell 22%, and investment by local private sector was up 34%. The high cost of doing business in the country deterred foreign investment. Reform of investment regulations focused on improved land tenure, the right of foreign companies to a greater shareholding in domestic businesses, and deregulation measures. Competition from other countries and recession in developed nations were other factors. The Government approved 313 foreign investment projects totaling $8 billion. Japan was the largest investor with a cumulative total of more than $13 billion.

GOVERNMENT POLICIES AND PROGRAMS

The Government encourages foreign investors to participate in the development of most of its mineral resources. It planned to establish a more conducive investment climate and provide investors with multiple incentives, including a more progressive tax system, softer loans from the Government banks, and reasonable customs and reduced tariffs on imported capital goods and exported commodities. Import tariffs on 36 iron and steel items had been cut or abolished. The Government also planned to sweeten the incentives for exploration in frontier areas that included a larger share of profits from oil production.

Foreign companies were allowed to hold more than 49% of a listed local company. The $50 million startup limit for 100% ownership also might be lowered for investment outside Java and developed areas of Sumatra. Under the latest plan, foreign investors in companies that make components or intermediate goods will be allowed to remain sole owners for 10 years if at least $2 million of equity is invested. In bonded zones, foreign investors who export all of their production will have to divest themselves of 20% within 20 years. Investors outside such zones will have to reduce their ownership to 49% after 20 years.

Five foreign mining companies were to obtain contracts of work for mineral resource exploration. For the first stage, total investment of the five companies should exceed $100 million. Twelve other foreign companies requested exploration rights, mostly for base metals.

PRODUCTION

The oil and gas sector continued to dominate the country's industrial production. Output of crude oil rebounded from a drop in 1992. Natural gas and coal continued their upward trend in production in response to increased exports.

In the non-oil minerals sector, production of copper and gold reached the highest levels in 5 years, being near 300,000 tons and 42 tons, respectively. Nickel ore output gradually increased, while production of nickel matte and ferronickel decreased slightly, as compared with those of 1992. Tin production stayed about the same level as that of the previous year owing to the depressed world market prices.

TRADE

The country exported almost all of the mine production and refined less than one-half of its crude oil output. Copper was exported in the form of concentrate

and nickel in the form of matte. All of Indonesia's refined copper requirements were imported from Chile, Japan, and Zambia. More than 95% of its tin production also was exported. Coal ranked second as an export commodity after processed wood products. Exports of liquefied natural gas (LNG) were expected to rise to 25.6 Mmt. Future production of LNG was to depend on the development of the Natuna gasfield in the South China Sea.

Japan was Indonesia's largest export market, accounting for 17% of non-oil exports, 53% of oil exports, and 80% of LNG exports. Indonesia was one of Australia's largest trading partners with a two-way trade in excess of $1.68 billion.

STRUCTURE OF THE MINERAL INDUSTRY

The Government resumed its privatization program. Two state cement companies, P.T. Semen Padang and P.T. Semen Tonasa, went public in 1993. However, none of the state-owned companies were ready to be privatized. Pertamina, Perum Gas Negara, and Perusahaan Umum Listrik Negara (PLN) are social service companies and are not going public.

The country has a labor force that is growing by about 2.3 million per year. The number of job seekers exceeds the number of positions available. There are shortages of skilled labor and managerial personnel, particularly for foreign-owned mining companies. The oil and gas sector has the largest number of workers, followed by the industrial minerals and tin industries.

COMMODITY REVIEW

Metals

Aluminum.—The Government formed a joint-venture company, P.T. Aldecom, to study the feasibility of setting up a 900,000-mt/a alumina refining plant on Bintan Island. The company is held by Government concern P.T. Aldevco (40%), Clarendon (20%), ABB Process Automation (20%), and Indonesian interests (20%). Bintan Island produced 1 to 1.2 Mmt/a of bauxite and about 500,000 to 700,000 mt/a was exported to Japan. Another 400,000 to 500,000 mt/a went to the United States. Total bauxite reserves would last for 5 to 6 years.

P.T. Alumindo modernized its hot mill at Surabaya and awarded a process control contract to Trafalgar House engineering division of Davy International. The automatic control of the mill was upgraded to improve productivity and reduce waste.

Copper.—P.T. Freeport Indonesia Co. operated eight ball mills with a throughput of 57,000 mt/d at its copper and gold mine in Irian Jaya in early 1993. In June, one of the four ore passes at mill level caved in, resulting in a partial blockage of one pass and the restriction of an adjacent pass. The average mill throughput was reduced to 40,000 mt/d. The expansion program, to 66,000 mt/d, however, continued with the installation of conveyors as an alternative to the ore pass systems. Current output, on a 66,000-mt/d operation, was 650,000 mt/a of copper concentrate containing 33% Cu, 21 g/mt Au, and 96 g/mt Ag.

Freeport Indonesia planned to increase throughput to 90,000 mt/d with an additional investment of $545 million. This was to be completed in 1996. In December, the company decided to expand further to 115,000 mt/d with the same completion date of 1996. The cost of this incremental expansion was estimated to be $140 million.

The Grasberg Mine produced a large amount of sediment that was not toxic and was moving down a river near the town of Tembagapura, with a population of 30,000. The company was constantly monitoring the environmental impact of its operations. An environmental group accused the company of polluting the Ajkwa, Pika, Uamiua, Aimua, and Minayerwi Rivers traversing Irian Jaya; however, the company denied the allegations.

Freeport Indonesia's parent acquired a 65% interest in Rio Tinto Minera, S.A. (RTM) of Spain for $54 million. It later acquired the remaining 35% at an undisclosed amount. The principal asset of RTM is a copper smelter with a production capacity of 150,000 mt/a of metal, consuming 450,000 mt/a of copper concentrate. The production capacity was to be expanded to 180,000 mt/a by 1995 at a cost of $33 million. Concentrate consumption was to be increased to 540,000 mt/a. Further expansion to 270,000 mt/a was under consideration at an additional $132 million. Freeport Indonesia has a long-term contract with RTM to provide the smelter with 100,000 tons of copper concentrate beginning in 1993 and 150,000 mt/a thereafter.

Delineation drilling was active at the Big Gossan copper-gold prospect from a new access adit being driven at the 2,900-m elevation. Airborne magnetometer surveys and surface drillings continued in the new contigous 2.6-Mha exploration area. The company was to spend $25 million on exploration in 1993, rising to $35 million in 1994.

Freeport Indonesia signed a letter of intent with ALatief Corp. of Jakarta for the acquisition of existing and to-be-constructed infrastructure assets valued at $200 million. The assets include shopping centers, commercial buildings, a guest house, multiunit housing, and a light industrial park. ALatief would be responsible for providing a major portion of the nonmining service that Freeport Indonesia required to support its activity and employees in Irian Jaya. Meanwhile, Freeport Indonesia sold the first group of nonmining assets valued at $90 million to a joint venture of ALatief and the company itself. Most of the assets were multifamily residential properties.

Freeport Indonesia sold its existing and to-be-constructed power transmitting and generating assets for $200 million to a joint venture owned 30% by Duke Energy Corp. of the United States, 30% by PowerLink Corp. of Canada, 30% by the company itself, and 10% by an unknown Indonesian investor. The joint venture was to sell power to Freeport Indonesia's mining operations.

Gold.—CRA's 90%-owned Kelian Mine produced more than 8,211 kg of

gold, exceeding its planned average output. Development cost was relatively high at $188 million. Preliminary studies were begun to increase its throughput to 6.5 to 7 Mmt/a of ore. The sulfide ore body contains about 50 Mmt of ore averaging 1.97 g/mt. Production was expected to reduce progressively as an increasing proportion of harder and more refractory ore was treated.

Ashton Mining of Australia sought partners to acquire controlling interests in its 90%-owned P.T. Indo Muro Kencana that was developing the Mount Muro gold property and in various other Indonesian gold prospects, including Kepala Burung in west Irian, Meares Soputan in north Sulawesi, and Mercu Buana in Kalimantan. P.T. Petrosea Indonesia commenced campsite building construction of the project. BHP Engineering continued the detailed design of the treatment plant. Plant commissioning was set for May 1994. At full capacity, Mount Muro was to produce 5,910 kg of gold. Ashton Mining spun off its gold interest to a newly created company, Aurola Gold Ltd., and retained only a 30% interest in Aurola.

Aurola Gold reached an agreement with Normandy Anglo Asia Co., whereby the latter could earn a 65% interest in its Kepala Burung contract work area in Irian Jaya by spending the first $6.9 million on exploration during the next 5 years. Aurola Gold was to retain a 25% equity and an Indonesian interest was to hold the remaining 10%. On Sangihe Island, Ashton's drilling program at the Bawone prospect indicated a substantial, but low-grade gold-copper ore body.

Meekatharra Minerals of Australia agreed to farm into two highly prospective gold properties in south Sumatra, currently 85% owned by Aurola Gold. The company was to spend $550,000, up to an additional $1 million on the Natarang area by June 1994, and $450,000 on Arai Liki by June 1995. This level of expenditure would give Meekatharra a 40.8% interest in the two areas. The first phase of a 3,000-m drilling program was expected to target three prospects, namely, Way Linggo, Bukit Ringgit, and Semung Kecil.

Dominion Mining of Australia agreed to acquire a 50% interest in the Minika project in Irian Jaya from Indonesian Setdco Mining Corp. for $15 million. The company was to manage a 3-year, $6 million exploration program in the 500-km^2 Minika work area, initially comprising mapping and geochemistry, to be followed by drilling. An aerial magnetometer survey indicated strong anomalies for two potential huge porphyry copper ore bodies. One was immediately north of the Grasberg/Ertsberg Mine and the other was in the southeast of the contract work area.

A joint-venture company, P.T. Irja Eastern Minerals Corp., between Eastern Mining Corp. (80%) of the United States, P.T. Indocopper Investama Corp. (10%), and P.T. Setco Ganesha (10%), was established to explore for and mine gold and copper in Irian Jaya. Eastern Mining Corp. is 80% owned by Freeport McMoRan Copper and Gold and is a sister subsidiary to Freeport Indonesia. The new venture was to have an authorized capital of $25 million and paid-up capital of $5 million. The company was expected to sign an exploration and mining contract with the Government.

Newmont Mining Corp. of the United States has two gold prospects, owning an 80% interest in each. The Minahasa deposits in Sulawesi contain an estimated 560,000 kg of gold mineralization. Development cost was estimated at $100 million, and production was scheduled to begin in 1995. The Batu Hijau project on the Island of Sumbawa has a total mineralization of 350 Mmt containing 2.268 Mmt of copper and 199,000 kg of gold.

Bre-X Minerals of Canada signed a memorandum of understanding with an Indonesian partner to acquire an 80% interest in two prospective gold claims covering 10,000 ha in central Sumatra. The company planned to file for a contract of work with the Government. In addition, the company acquired an 80% interest in the Busang gold property in central east Kalimantan. Three prime prospects were identified in the 57,570-ha Muara Atan contract area. Geological resources of 20 Mmt at more than 2 g/mt gold were indicated by prior work. Separately, the company agreed to acquire a 55% interest in a porphyry copper-gold prospect at Taware Valley under the Meares Soputan contract of work on Sangihe Island, north Sulawesi, that had a potential resource of 80 Mmt grading 0.5% copper and 0.7 g/mt gold.

P.T. Aneka Tambang, the state-owned mining company, expanded its gold exploration activities at Gunung Pongkor and Cikadeng, both near Cikotok, west Java. The mine at Gunung Pongkor, estimated to have a gold reserve of 80 tons, was to start production in early 1994.

Iron and Steel.—Indonesia and Japan signed a memorandum of understanding for a period of 4 years that provided for the introduction of Japanese energy-saving technology on a pilot basis at the Indonesian steel mills. This was to use a $12.8 million grant provided by the Japanese Government.

State-run P.T. Krakatau Steel planned production expansion to boost export from the current 100,000 mt/a to 500,000 mt/a by 1995. The expansion program costing $480 million was to raise steel capacity from the current 1.5 Mmt/a to 2.5 Mmt/a by adding a second hot steel production unit. The steelmaker was conducting a study to build a new 3- to 3.5-Mmt/a steel plant in the future. The company also planned to boost its direct-reduced iron output to 2.3 Mmt/a in January 1994. Negotiations with Cia. Minera del Pacifico S.A. of Chile for a trial order of pellets for the new direct reduction module continued. The direct reduction to scrap ratio at the steel meltshops was to be 80:20.

Krakatau Steel planned to increase output of wire rod by 25%, from 20,000 mt/month to 25,000 mt/month, after signing a technical assistance agreement with Kobe Steel of Japan. Krakatau engineers were to attend training at Kobe Steel's Kakogawa works. During the year, Krakatau Steel commissioned a new 800,000-mt/a slab plant constructed by

Voest Alpine Industrieanlagenbau. In early 1993, the company increased the capacity of its 1.2-Mmt/a hot strip mill to 2 Mmt/a, but operated the mill mostly at 1.8 Mmt/a. A new slab sizing press was being installed for commissioning in March 1995. About 20% of Krakatau Steel's products was exported.

BHP Steel, in a joint-venture project, was to construct $75 million metallic coating and paint lines at Cilegon. The project was due to be completed in early 1995. The company was to supply high-quality steel feed to Krakatau Steel to convert into cold-rolled coils for the new facility.

P.T. Rajabesi and Kao Hsing Chang, a Taiwanese cold roller and pipemaker, formed a joint-venture company, P.T. Little Giant Steel Corp., to build two cold strip mills at Semarang, central Java. The first cold-rolling mill, with a capacity of 150,000 mt/a, was to produce 1.2-mm strip for use in the pipe plant and other manufacturing areas. The company already has a 120,000-mt/a pipe mill and planned to add another plant. The target opening date for the $10 million new mill was mid-1994. The second cold-rolling mill was for a 0.2-mm line with a capacity of 250,000 mt/a.

Nickel.—P.T. Inco Indonesia's output of nickel in matte was all sold to Japan under long-term contracts: 20% to Sumitomo Metal Mining and the rest to Tokyo Nickel (45% owned by Inco). Production of contained nickel decreased 5.5% to 34,300 tons owing to the overhaul of its No. 2 furnace at Sorako, Sulawesi, in July. The company was contemplating to expand its rated capacity from 34,000 mt/a to 45,400 mt/a and operate at full capacity by 1994. Benefiting from its own hydroelectric powerplant, P.T. Inco remained among the world's lowest cost producers.

P.T. Aneka Tambang produced 2.35 Mmt of nickel ore and 42,400 tons of nickel in matte. Exports were 2 Mmt and 42,400 tons, respectively. Output of nickel in ferronickel was 5,500 tons. The mine at Gebe Island has a capacity of 23,000 mt/a of nickel in matte and that at Pomalaa rates at 14,000 mt/a. The company was doubling its capacity at Pomalaa to 10,000 mt/a of nickel in ferronickel by 1994. Aneka Tambang was to be publicly traded on the Jakarta Stock Exchange in 1994 and was expected to raise between $43 million and $87 million for Government funds. The proceeds were expected to finance several projects, including the expansion of the Pomalaa ferronickel plant and the construction of a gold mine with a production capacity of 3 mt/a gold at Gunung Pankor.

The regional government in Irian Jaya welcomed inward investment in the mining sector because the area contains major reserves of nickel, precious stones, and other minerals. Ore reserves of 100 Mmt grading 1.5% nickel and 0.5% cobalt had been identified in Kebar and on nearby Wigeo Island.

Tin.—Indonesia was the largest tin producer of the Association for Tin Producing Countries. P.T. Tambang Timah, the state mining company, accounted for 80% of the country's tin production. Output was estimated at 29,000 tons and exports fell to 26,400 tons. Smelting capacity of tin concentrate was 32,000 mt/a. Most of the output (90%) was exported, with 50% going to Asian countries that had greatest growth potential and the rest to the United States and Europe.

Tambang Timah has been restructuring its operations since 1990 to improve efficiency, productivity, and competitiveness. At the end of 1993, about 14,000 jobs had been eliminated. Noncore businesses had been eliminated and social commitments relinquished. Relocation of headquarters to Bangka sped up the decisionmaking process and reduced overheads. Technical improvements had been made to production equipment and supporting facilities. Staff development, education, training, and human resources management all were involved in restructuring.

P.T. Koba Tin added another dredge to its operations on Bangka Island, Sumatra, expanding production from 7,500 to 10,000 mt/a. The company is owned 75% by Renison Goldfield Consolidated, Ltd. and 25% by Tambang Timah.

Industrial Minerals

Cement.—P.T. Semen Gresik continued work on its 2.3-Mmt/a cement plant in Java. The project includes a vertical mill for raw material grinding, a rotary kiln, and a two-string, five-stage preheater tower with two calciners. P.T. Semen Padang also continued work on its modernization/expansion (to 5,400 mt/d) program at its Indarung plant, and commissioning was in mid-1993. P.T. Semen Tonasa planned to expand its Sulawesi plant with a 7,500-mt/d production line that was to include a four-stage precalciner kiln with grate cooler, and commissioning was expected in 1994.

Zeolite.—Paragon Resources of Australia was granted a contract of work for its 70%-owned Mount Ratai zeolite project. Drilling indicated the thickness of the zeolite bed ranged from 11 to 51 m. Sales of zeolite to a major Australian fertilizer company were expected.

Mineral Fuels

Carbon Black.—P.T. Cabot Indonesia, a unit of Cabot Corp. of the United States, was to spend $24.5 million to double capacity of its plant at Cilegon to 60,000 mt/a. The plant started production in May 1992. Completion of expansion was scheduled for 1995. The only other producer is Continental Carbon Indonesia at Merak with a capacity of 30,000 mt/a.

Coal.—The country's annual coal output stood at 35 Mmt from coal reserves of 36 billion tons and was expected to grow to 40 Mmt in 1994. About 67% of Indonesian coal reserves is in Sumatra. Taiwan was one of the largest recipients of Indonesian coal, importing 2.6 to 3 Mmt/a. High-quality coal was exported to Europe in addition to ASEAN countries and amounted to 18 Mmt.

China Coal Mining Equipment Corp.

and P.T. Tambang Batubara Bukit Asam, the state coal mining company, signed an agreement to jointly construct six coal processing plants in Indonesia with a combined capacity of 3 Mmt/a. In the first phase of the project, the Chinese partner was to build two 500,000-mt/a plants, one in east Java and the other in west Java. Both were due to come on-stream in 1994.

P.T. Kideco Jaya Agung's new open-cut coal mine, 150 km south of Balikpapan in east Kalimantan, started production in October. The coal strata varied in thicknesses of 3 to 40 m, and output was expected to be 1.2 Mmt in 1994 and 2 Mmt in 1995. Production from P.T. Kaltim Prima Coal was increased, and partners BP (50%) and CRA (50%) attributed totally 15% share to the Indonesian state coal authority.

Korea-Indonesia Resources Development Co. of South Korea extracted coal from its mine at Pasir in eastern Kalimantan after investing $142 million in mine development. The mine has a production capacity of 2.3 Mmt/a to be increased to 4 Mmt/a and proven reserves of 942 Mmt, of which 455 Mmt is minable. The primary consumer was Korea Electric Power Corp., taking in 1 Mmt/a currently, and the rest of production was to be exported.

The Petangis property in Kalimantan of P.T. Utah, a subsidiary of BHP Minerals, was contract mined for coal. Production of 1 Mmt/a was commenced in 1993 by the mining contractor at a contracted price per ton delivered. P.T. Utah was to oversee the operation and be responsible for marketing coal. P.T. Utah also owns 80% of Senakin and Satui steam coal mines in south Kalimantan. An expansion of the operations and an associated port development was due for completion in 1994.

Twenty Indonesian firms were to sign contracts with P.T. Tambang Batubara Bukit Asam to mine coal in Sumatra, Kalimantan, and Irian Jaya. Private contractors mined 22 Mmt of coal out of the 35 Mmt produced in the country. A consortium led by three foreign companies, Ban-Pu International of Thailand, Clough Engineering, and P.T. Sitrade Musa Globus, applied for concessions to mine coal in Kalimantan and Sumatra.

Liquefied Natural Gas (LNG).—Indonesia is the single largest supplier of LNG, and Japan is the largest consumer in the world. The country exported 19 Mmt/a of LNG to Japan, the Republic of Korea, and Taiwan.

Lasmo holds interests in three operated production-sharing contracts (Malacca Strait, Cumi Cumi, and Runtu) and three nonoperated contracts (Sanga Sanga, Kakap, and Madura). Gas from the producing fields flowed to the Bontang LNG plant where a sixth processing train commenced production in 1993. Pertamina granted commercial development for gas in the Madura contract, of which Lasmo holds 12.58% interest; project startup was expected in 1997.

Total SA of France helps develop the country's natural gas fields in east Kalimantan and Natuna. Drillings were active in the Mahakam River, Peciko, and Nubi Fields. Development was proceeding on the second phase of the Tunu Field and was to be completed by yearend. Total's gas reserves were expected to play a key role in export strategy when the giant Natuna Sea Fields were developed.

The Government canceled an agreement with Exxon Corp. of the United States on development of the $40 billion Natuna Sea gas project, which was estimated to have reserves of 4.25 trillion m^3 of gas. Exxon sought a 70% stake in the project and was one of a few companies having the expertise or financial means to promote such a huge undertaking. Development of the estimated 1.27 trillion m^3 of recoverable reserves would enable long-term contracts for 14 Mmt/a of LNG.

Petroleum.—Pertamina awarded Canadian and U.S. companies oil exploration and production-sharing contracts in Pasemah bloc, south Sumatra; Jambi Province, Sumatra; Wiriagar patch, Irian Jaya; and North Tanjung, central Kalimantan, covering a total area of 23,700 km^2. Thirteen new oil contracts were signed in 1993. Indonesia was expected to increase its crude oil production to 1.5 Mbbl/d during the next 8 years.

The country agreed to increase shipments of coal to Taiwan from 2.6 Mmt to 3.05 Mmt/a, crude oil from 50,000 bbl/d to 200,000 bbl/d, and LNG from 1.5 Mmt/a to 2.25 Mmt/a in exchange for Taiwan's participation in joint oil exploration in Sumatra and assistance in building an oil refinery and hydroelectric powerplants. China Petrochemical Corp. planned to invest with local partners in a proposed oil refinery and fertilizer plant in Indonesia. The investment was expected to total about $3 billion.

A group of Korean oil and gas companies sought farming into petroleum exploration and production activities in Indonesia. These companies included Korea Petroleum Corp., Dae Woo Corp., Hyundai Corp., Kodeco Energy Co., Korea Indonesia Resources Development Co., Lucky Goldstar International, Ssangyong Corp., and Korea Overseas Petroleum Development Association.

Lasmo of the United Kingdom is one of the country's largest oil and gas producers. The major source of production was from Sanga Sanga, and gas produced was converted into LNG and sold to Japan, the Republic of Korea, and Taiwan. Development plans from two new fields were at the preliminary engineering stage, with production projected for early 1995. Commercial development was granted by Pertamina for a gasfield in the Madura production-sharing contract area.

Maxus Energy Corp. of the United States was to sell its 24.27% interest in the 2.3-Mha production-sharing contract operated by ACRO in Northwest Java. Maxus netted about 18,000 bbl/d of oil from the contract area's production of 130,000 bbl/d. Meanwhile, Conoco of the United States had been producing 80,000 bbl/d from its Belida Field since yearend 1992.

Japan's Indonesia Petroleum made another discovery of condensate and natural gas in the Mahakam offshore

concession off east Kalimantan. The company has been developing the concession jointly with Total Indonesia under a production-sharing contract with Pertamina.

Mitsui Oil Exploration of Japan acquired a 35% development right from Enterprise Oil Indonesia to the Kakap Oilfield in Natuna Sea. Enterprise Oil, the operator, retains 35% interest and Saga Petroleum Natuna Sea has the remaining 30%. Appraisal drilling was to start in the first quarter of 1994. The Kakap Field was estimated to have reserves of 200 Mbbl of oil.

Reserves

Indonesia is one of the mineral resource-rich countries in Southeast Asia. The major mineral commodities are bauxite, coal, copper, natural gas, nickel, petroleum, and tin. Crude oil and natural gas are the most abundant and occur onshore and offshore Sumatra, offshore north Java, and onshore and offshore east Kalimantan. Bauxite reserves are significant and concentrated on Bintan Island and west Kalimantan. Coal is found in west and south Sumatra. Copper reserves are in the Ertsberg and Grasberg areas of Irian Jaya. Nickel reserves are large and mainly in south Sulawesi, on Gebe Island, and on Gag Island. Tin reserves also are abundant and found onshore and offshore Bangka Island and around nearby islands of Belitung, Karimum, Kundur, and Singkep.

INFRASTRUCTURE

PLN completed the construction of a 400-MW coal-fired powerplant at Paiton in east Java. It also planned to build three additional 400-MW powerplants at Surabaya, two more 65-MW units at Bukit Asam, and two 100-MW plants near the Ombilin coal mine in west Sumatra. Negotiations for the first $2 billion phase of the large-scale Paiton power station were in their third year. The extension of harbor facilities at heavily congested Tanjung Priok, Jakarta's main port, suffered considerable delays. Some domestic private capital was found for the toll road program, which failed to attract foreign investment. The Government's spending on electric power, telecommunication, and road infrastructure costs was likely to exceed $50 billion by the end of the decade.

OUTLOOK

Although the short-term outlook for the economy is good, the Government must remove some significant obstacles to ensure it. In the mining sector, the exploration and development of coal and gold in Kalimantan and Sumatra will be very active in the near future. Coal production is forecast to be 30 Mmt in 1994. Indonesian coal is not only designated as an export commodity, but also used as a fuel substitute for oil for the country's powerplants. Gold output continues to increase and is expected to reach 40 tons in 1994. Gold exploration is being conducted all over the country. It is anticipated that foreign participation in capital investment and potential sales for equipment, engineering services, and other goods will substantially increase.

[1]Where necessary, values have been converted from Indonesian rupiah (Rp) to U.S. dollars at the rate of Rp2,104=US$1.00 for 1993.

OTHER SOURCES OF INFORMATION

Agencies

Department of Mines and Energy
Jl. Jend. Gatot Subroto kav. 49
Jakarta 12790, Indonesia
Directorate of Mineral Resources and
Geological Research and
Development Center
Jl. Diponegoro 57
Bandung 40122, Indonesia
Directorate General of Oil and Gas
Jl. M.H. Thamrin No. 1
Jakarta Pusat, Indonesia

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TABLE 1
INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
METALS							
Aluminum:							
Bauxite, gross weight	thousand tons	862	1,206	1,406	804	1,320	1,300
Metal, primary		196,869	185,863	187,000	173,000	205,526	225,000
Chromite sand, dry basis		7,635	e8,000	1,950	e2,000	e2,500	NA
Copper, mine output, Cu content		143,970	164,110	211,692	280,819	298,648	NA
Gold, mine output, Au content[2]	kilograms	6,155	11,158	16,879	37,983	42,097	NA
Iron and steel:							
Iron sand, dry basis		142,654	145,401	173,242	287,821	341,335	NA

See footnotes at end of table.

TABLE 1—Continued

INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
METALS—Continued							
Iron and steel—Continued:							
Metal:							
Ferroalloys: Ferronickel		26,058	25,025	e25,000	e26,000	e27,000	NA
Steel, crude		2,383,000	2,892,000	3,250,000	3,171,072	1,947,511	3,500,000
Manganese ore		9,364	9,417	13,253	e13,000	e14,000	NA
Ferromanganese		—	—	—	—	10,000	NA
Nickel:							
Mine output, Ni content[3]		62,987	68,308	71,681	77,600	e80,000	NA
Metallurgical products:							
Matte: Ni content		29,030	24,949	27,433	39,307	36,987	48,000
Ferronickel: Ni content		4,964	5,005	5,318	5,506	5,266	NA
Silver, mine output, Ag content	kilograms	73,884	67,315	80,294	99,941	90,301	NA
Tin:							
Mine output, Sn content		31,263	30,200	30,061	29,400	e29,000	38,000
Metal		29,916	30,389	30,415	31,915	30,415	32,000
INDUSTRIAL MINERALS							
Cement, hydraulic	thousand tons	14,099	13,762	16,153	17,280	18,934	20,000
Clays:							
Bentonite		3,863	5,914	21,512	17,960	13,707	NA
Fireclay[e]		r1,730,834	1,800,000	1,850,000	1,900,000	1,950,000	NA
Kaolin powder		157,122	160,098	139,915	230,550	42,365	NA
Diamond:[e]							
Industrial stones	thousand carats	25	23	24	21	20	NA
Gem	do.	7	7	8	6	7	NA
Total	do.	32	30	32	27	27	NA
Feldspar		13,025	19,779	13,674	16,719	27,835	NA
Gypsum		449	58	404,310	e400,000	1,646	NA
Iodine	kilograms	14,275	59,820	36,353	e35,000	14,180	NA
Nitrogen: N content of ammonia		2,526,400	2,789,000	2,706,268	2,687,818	2,888,000	3,462,000
Phosphate rock		10,549	1,600	6,384	e8,000	e7,000	NA
Salt, all types[e]	thousand tons	600	600	610	630	650	NA
Stone:							
Dolomite		68,731	10,537	e10,000	11,414	4,534	NA
Granite	thousand tons	1,195	e1,200	e1,200	2,907	2,767	3,000
Limestone	do.	10,199	9,510	2,573	3,796	e4,000	NA
Marble	square meters	1,112	1,013	378	1,989	3,000	NA
Quartz sand and silica stone		301,706	165,198	429,251	e400,000	239,769	NA
Sulfur, elemental		3,890	3,628	e3,600	e3,600	e3,500	NA
Zeolite		640	e600	e600	70	60	NA
MINERAL FUELS AND RELATED MATERIALS							
Coal	thousand tons	8,812	10,769	13,688	22,357	27,583	30,000
Gas, natural:							
Gross	million cubic feet	1,975,421	2,158,921	2,035,058	2,582,641	2,661,878	NA
Marketed[e]	do.	r1,397,873	1,500,000	1,400,000	1,600,000	1,600,000	NA

See footnotes at end of table.

TABLE 1—Continued

INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
MINERAL FUELS AND RELATED MATERIALS—Continued							
Petroleum:							
Crude including field condensate	thousand 42-gallon barrels	514,184	533,666	581,232	550,668	557,661	NA
Refinery products:							
Liquefied petroleum gas	do.	3,245	3,467	3,453	4,224	e3,600	NA
Gasoline	do.	36,580	39,003	42,137	43,814	e45,000	NA
Jet fuel	do.	7,223	5,439	6,580	6,341	e6,000	NA
Naphtha	do.	12,696	18,471	14,078	12,435	e20,000	NA
Paraffin wax	do.	143	121	183	140	e190	NA
Kerosene	do.	43,500	45,630	47,326	48,996	e50,000	NA
Distillate fuel oil	do.	84,307	72,418	76,592	82,046	e77,000	NA
Lubricants	do.	1,504	1,641	1,462	1,724	e1,600	NA
Residual fuel oil	do.	40,565	26,864	26,975	28,992	e30,000	NA
Unfinished oil requiring further processing	do.	e1,600	41,813	44,251	50,820	e43,000	NA
Refinery fuel and losses	do.	13,409	15,262	12,490	12,569	e14,000	NA
Unspecified	do.	2,046	1,074	2,936	842	e2,500	NA
Total	do.	e246,818	271,203	278,463	292,943	e292,890	NA

eEstimated. pPreliminary. NA Not available.

[1]Table includes data available through June 15, 1994.

[2]Includes Au content of copper ore and output by Government-controlled foreign contractors' operations. Gold output by operators of so-called people's mines and illegal small-scale mines is not available but may be as much as 18 tons per year.

[3]Includes a small amount of cobalt that is not recovered separately.

[4]Reported figure.

TABLE 2

INDONESIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum:			
Bauxite	P.T. Aneka Tambang (Government, 100%)	Kijang, Bintan Island	1,300
Metal	P.T. Indonesia Asahan Aluminum (Nippon Asahan Aluminum Co. of Japan, 59%; and Government, 41%)	Kual Tanjun, north Sumatra	225
Cement	P.T. Indocement	Citeureup, west Java	8,000
Do.	P.T. Semen Cibinong	Narogong, east Java	1,400
Do.	P.T. Semen Gresik	Gresik, east Java	1,500
Do.	P.T. Semen Padang	Indarung, west Java	2,200
Coal	P.T. Allied Indo Coal (Allied Indonesia Coalfields Pty. Ltd. of Australia, 60%; and P.T. Mitra Abadi Sakti of Indonesia, 20%)	Parambahan, west Sumatra	500
Do.	P.T. Tambang Batubara Bukit Asam (Government, 100%)	Bukit Asam, south Sumtra	4,000
Do.	Perum Tambang Batubara (Government, 100%)	Ombilin, west Sumtra	1,000
Copper, concentrate	P.T. Freeport Indonesia Co. (Freeport McMoRan Copper and Gold Inc. of the United States, 80%; Government, 10%; and others, 10%)	Ertsberg and Grasberg, Irian Jaya	350
Granite	P.T. Karium Granite (subsidiary of P.T. Pandawa Sempurna of Indonesia)	Karium Island	2,000

TABLE 2—Continued

INDONESIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Petroluem, crude thousand barrels per day	Atlantic Richfield Indonesia, Inc. (subsidiary of ARCO of the United States)	Arjuna and Arimbi, offshore west Java	170
Do.	Maxus Southeast Asia Ltd. (subsidiary of Maxus Energy of the United States)	Cinta and Rama, offshore southeast Sumatra	95
Do.	PERTAMINA (Government, 100%)	Jatibarang, west Java, and Bunyu, offshore east Kalimantan	80
Do.	P.T. Caltex Pacific Indonesia (Texaco Inc., 50%; and Chevron, 50%, both of the United States)	Minas, Duri, and Bangko, central Sumatra	700
Do.	Total Indonesia (subsidiary of Compagnie Francaise des Petroles of France)	Handi and Bakapai onshore and offshore east Kalimantan	180
Gas:			
Natural million cubic feet per day	Mobil Oil Indonesia, Inc. (subsidiary of Mobil Corp. of the United States)	Arun, Aceh in north Sumatra	1,700
Do.	Roy M. Huffington (subsidiary of HUFFCO of the United States)	Badak, east Kalimantan	1,000
Liquefied	P.T. Arun LNG Co. Ltd. (Government, 55%; Mobil Oil, 30%; and the Japan Indonesia LNG Co., 15%)	Balang Lancang, Aceh in north Sumatra	10,000
Do.	P.T. Badak LNG Co. Ltd. (Government, 55%; HUFFCO Group, 30%; and the Japan Indonesia LNG Co., 15%)	Bontang, east Kalimantan	7,900
Nickel:			
In ore	P.T. Aneka Tambang (Government, 100%)	Pomalaa, south Sulawesi and on Gebe Island, Moluccas,	34
In matte	P.T. International Nickel Indonesia (Inco Ltd. of Canada, 78%; Sumitomo Metal Mining Co. Ltd. of Japan, 20%; other, 2%)	Soroako, south Sulawesi	48
Nitrogen	P.T. Aseah-Aech Fertilizer (Government, 60%; other members of Asean, 40%)	Lhokseumawe, north Sumatra	506
Do.	P.T. Pupuk Iskandar Muda (Government, 100%)	do.	506
Do.	P.T. Pupuk Kalimantan Timur (Government, 100%)	Bontang, east Kalimantan	1,012
Do.	P.T. Pupuk Sriwijawa (Government, 100%)	Palembang, south Sumatra	1,438
Steel, crude	P.T. Krakatau Steel (Government, 100%)	Cilegon, west Java	2,000
Tin:			
In ore	P.T. Koba Tin (Government, 25%; Renison Goldfields Consolidated Ltd. of Australia, 75%)	Koba, Bangka Island	6
Do.	P.T. Tambang Timah (Government, 100%)	Onshore and offshore islands of Bangka, Belitung, and Singkep	32
Metal, refined	Peleburan Timah Indonesia (Government, 100%)	Mentok, Bangka Island	32

TABLE 3

INDONESIA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Bauxite		[1]396,000
Coal		[2]3,000,000
Copper		[3]676,000
Gas, natural	billion cubic feet	87,015
Nickel		[4]367,000
Petroleum, crude	million barrels	8,200
Tin		[5]740

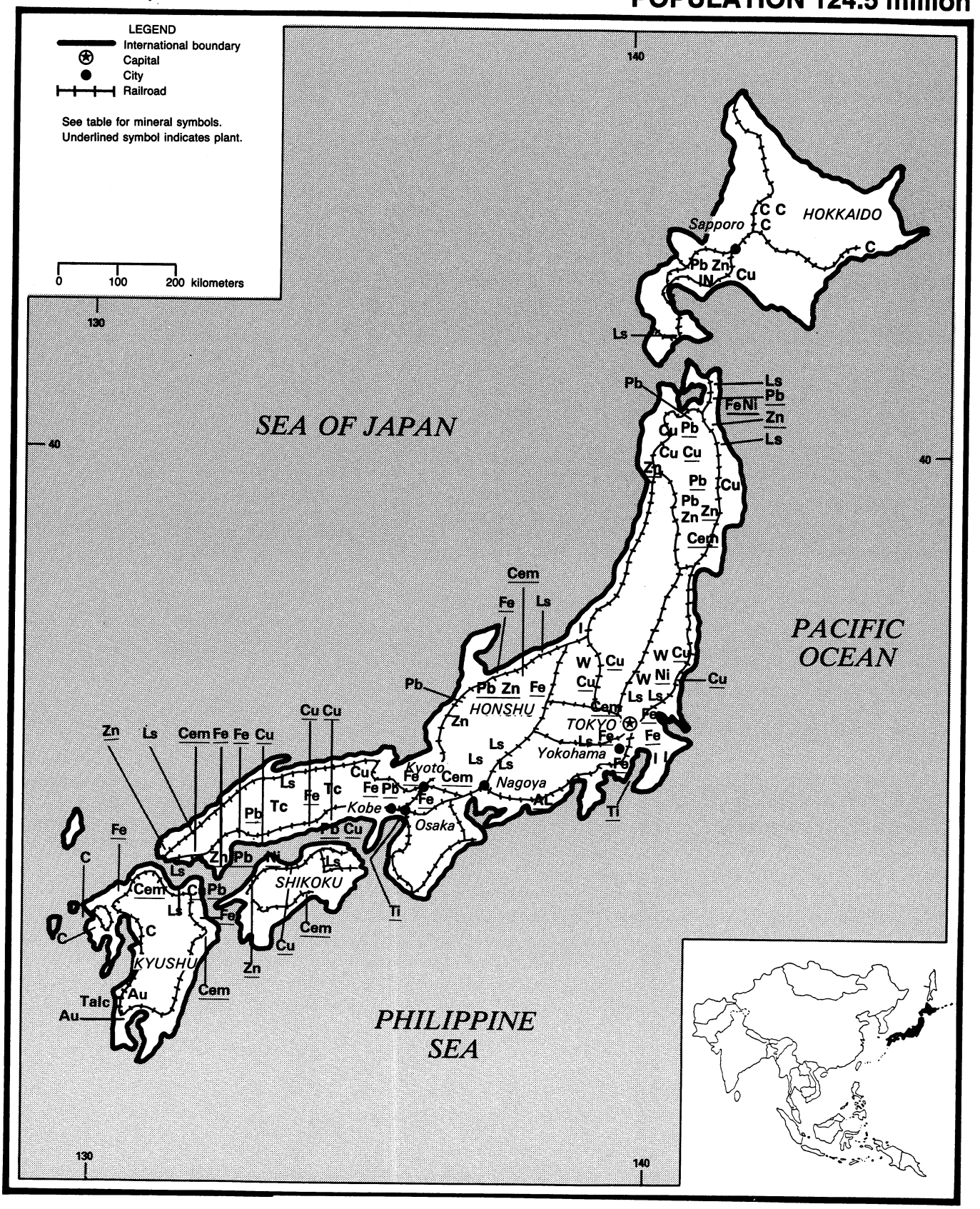
[1]Includes proven reserves on Bintan Island and west Kalimantan, grading no less than 40% Al_2O_3.
[2]Includes proven and probable reserves.
[3]Represents proven and probable reserves, grading 1.4% Cu, in the Ertsberg and Grasberg areas of Irian Jaya.
[4]Represents proven and probable reserves on Gag Island, Gebe Island, in the Pomalaa and Soroako areas of south Sulawesi, grading between 1.5% to 2% Ni.
[5]Official proven reserves.

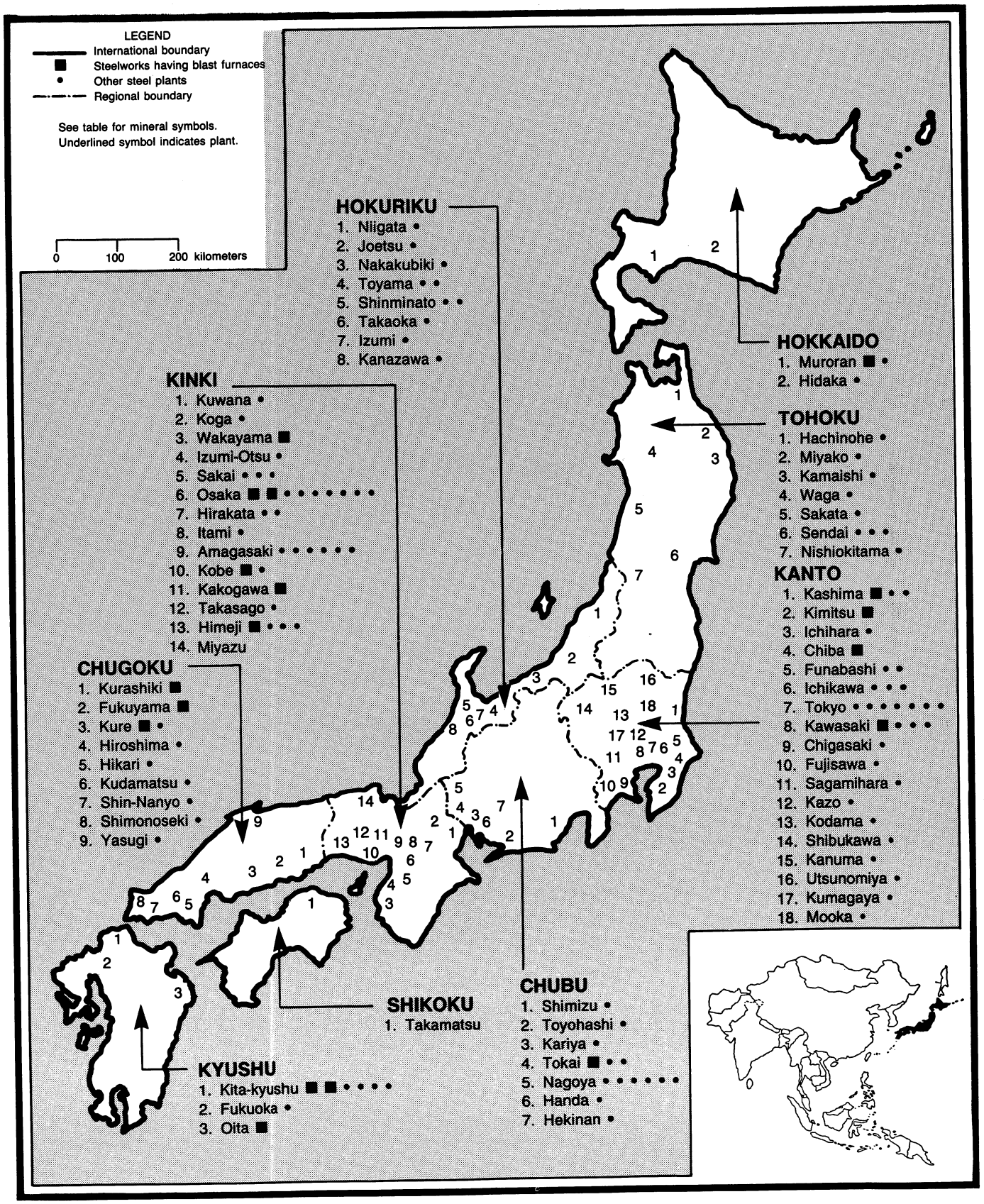
Sources: The Indonesian Department of Mines and Energy, the Indonesian Mining Association, P.T. Freeport Indonesia Co., P.T. Inco., and Oil and Gas Journal.

JAPAN

AREA 377,835 km²

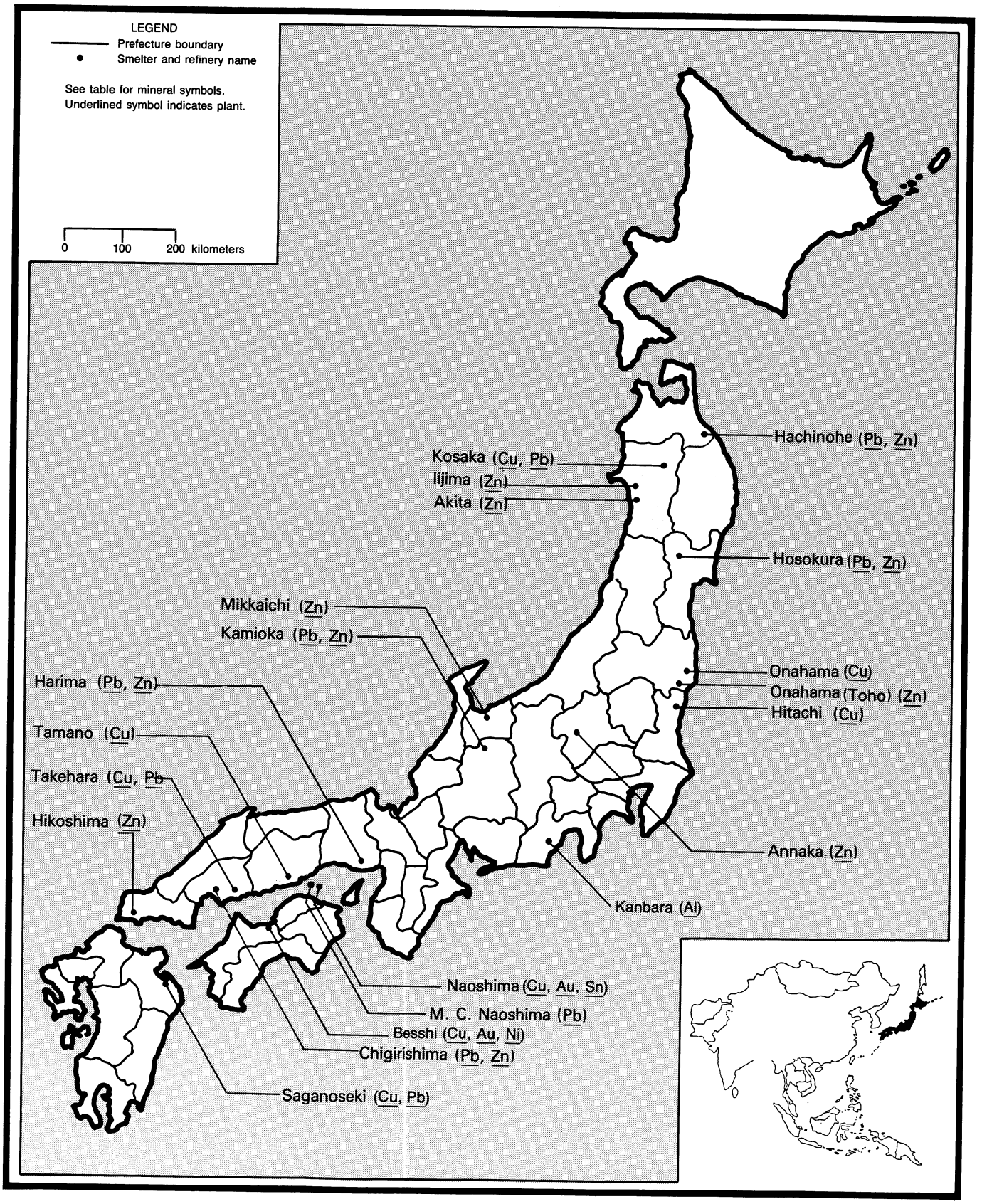
POPULATION 124.5 million





The Japan Iron and Steel Federation (Tokyo) publication adapted from *The Steel Industry of Japan, 1992.*

JAPAN: LOCATION OF MAJOR STEELWORKS



Metal Mining Agency of Japan (Tokyo) publication adapted from *Mining Activities of Japan, 1992*

JAPAN: LOCATION OF MAJOR NONFERROUS SMELTING AND REFINING PLANTS

THE MINERAL INDUSTRY OF

JAPAN

John C. Wu

In 1993, Japan was the world's largest producer of cadmium metal, indium metal, iodine, electrolytic manganese dioxide, pig iron, pyrophyllite, selenium metal, steel, and tellurium metal. It was the world's second largest producer of high-purity gallium metal, titanium sponge, and zinc metal. Japan remained the third largest producer of cement, copper metal, limestone, and nickel metal. Japan was one of the world's top six producers of bismuth metal, bromine, gypsum, lime, primary magnesium, sand and gravel, silica sand, and sulfur. Reserves of crude petroleum, natural gas, and most nonfuel minerals in Japan are very small. However, Japan's reserves of iodine, limestone, silica stone and sand, and pyrophyllite are large and of world significance.

Japan is a major world market for metals and minerals. It is one of the world's three largest consumers of primary aluminum, cadmium metal, chromite, coal, cobalt metal, copper ore and metal, diamond, ferrochromium, fluorspar, gallium metal, iron ore, ilmenite and rutile, industrial salt, lead metal, liquefied natural gas (LNG), manganese ore, nickel ore and metal, crude petroleum, potash, phosphate rock, precious metals, rare earths, silicon, steel, zinc ore and metal, and zircon. On the other hand, Japan is one of the world's top exporters of cement, fertilizer materials, iodine, electrolytic manganese dioxide, high-purity rare metal products, iron and steel products, and titanium sponge and mill products.

The mining sector of Japan's mineral industry remained small. According to Japan's Economic Planning Agency, the latest statistics available for Japan's gross domestic product (GDP), in 1985 constant dollars, was $3.3 trillion in 1992, compared with $3.1 trillion in 1991. The value of output by the mining sector was $8.6 billion,[1] accounting for 0.26% of Japan's GDP in 1992. The mineral processing sector continued to play an important role in providing the basic materials for its large world-class manufacturing sector. Japan's mineral processing sector also provided considerable quantity of ferrous and nonferrous metals to neighboring countries, especially supplying refined copper, refined lead, steel products, and slab zinc to China, the Republic of Korea, and Taiwan.

Japan remained an important market for U.S. exports of primary aluminum; beryllium metal; boron oxide and acid; chromium oxide and hydroxide; coal; copper (concentrate and metal); ferrous and nonferrous scrap metals; lead ore and concentrate; lithium oxide and hydroxide; dust and powder of precious stones (abrasive); primary magnesium; molybdenum (concentrate and metal); phosphate rock; rare-earth compounds; high-purity silicon; soda ash; tantalum metal and powder products; refined petroleum products, especially petroleum coke; uranium oxide and other compounds; and zinc ore and concentrate. On the other hand, Japan continued to be an important supplier of fabricated aluminum mill and copper mill products, cement, iodine, iron oxide, high-purity rare metals, high-quality steel products, and titanium sponge, scrap; and powder to the United States.

Japan remained a large net importer of mineral commodities in 1993. According to the Ministry of Finance, mineral commodities imports, which included metallic ore and scrap, coal, crude and refined petroleum, LNG, iron and steel products, and nonferrous metals, decreased by 6.5% to $66.5 billion in 1993. Japan's mineral commodity exports, which included metallic and industrial mineral products, increased by 7% to $28 billion in 1993. Japan's mineral trade deficit declined from $46 billion in 1992 to $40 billion in 1993 because of decreased imports in every category of minerals products, and increased exports in all categories of mineral and metal commodities.

In 1993, imports of mineral fuels were $48.8 billion, of which $28 billion was for crude and partially refined petroleum, $5.1 billion for refined petroleum products, $5.9 billion for anthracite and bituminous coal, and $9.8 billion for LNG and other fuels. Imports of metallic ore and scrap totaled $6.9 billion, of which $3 billion was for iron ore and $3.9 billion for nonferrous metal ore and ferrous and nonferrous scrap. Japan's imports of iron and steel products and nonferrous metals totaled $10.7 billion, while exports of iron and steel, nonferrous metals, and other metal products totaled $22.9 billion. Exports of industrial mineral products totaled $4 billion in 1993.

GOVERNMENT POLICIES AND PROGRAMS

Because of the weakened competitive position of Japan's mineral industry in the world market owing to higher Japanese yen value and new Government policy toward a cleaner living environment, the Japanese Government modified its mineral policy in 1993 and added new objectives to the underlined principal objective of securing a stable supply of

minerals. These new objectives are to develop a sound mineral industry through promotion of technological innovation and to preserve a good environment for human life through development and transfer of antipollution technology to developing countries. Implementation of Japan's mineral policy was through the Metal Mining Agency of Japan (MMAJ), a semi-Government agency under the supervision of the Ministry of International Trade and Industry (MITI).[2]

To implement these new policy objectives, MMAJ is expected to establish a mineral technology research center with a capital of about $4 million in 1994. The center is to promote and conduct research and development (R&D) on new technology for mineral exploration, mineral processing, and on new technology for prevention of mining-related pollution beginning in 1995. In 1993, MMAJ reportedly had developed a new technology by using sulfate-deoxidizing bacteria for removing heavy metals, such as cadmium, copper, and zinc from mine drainage. MMAJ planned to tested this new technology at various domestic mines for the next 5 years beginning in 1994.

According to local press reports, MITI, through its affiliated Agency of Industrial Science and Technology (AIST), is to coordinate a 3-year R&D project in the fiscal year beginning in April 1994 to develop new smelting technologies, which are less polluting and less energy intensive. The new techniques, such as optical leaching (photoleaching); biological leaching, which use bacteria to oxidize iron; and zapping ore with microwaves to melt out the sulfur component, are to be investigated. The advantages of these new techniques include: (1) metals can be extracted at room temperature with less energy, (2) metals can be extracted without generating carbon dioxide and sulfur oxides, and (3) metals can be extracted with low-grade ore. The project is to be conducted jointly by AIST, MMAJ, and Tohoku University, the top metals research university in Sendai, northeastern Japan.[3]

To secure a long-term stable supply of mineral resources and to strengthen the competitiveness of the nonferrous mineral processing industry, according to MITI, Japan will intensify exploration of nonferrous minerals overseas and will seek joint development agreements with foreign companies. The targeted overseas areas included Russia, Central Asia, and Latin America.

In the spring of 1993, the Government sent a 15-member mission led by officials of MMAJ to Kazakhstan and Uzbekistan for a 2-week study tour on mining and smelting of copper, gold, lead, rare earths, and zinc in those two countries.

In June, MMAJ reached an agreement with the Vietnamese Government for exploration of copper, gold, lead, nickel, tin, tungsten, and zinc in the Van Yeh and Thanh Hoa regions, about 2,000 km^2 each, 150 km west and south, respectively, of Hanoi. The estimated cost of the 3-year exploration project is between $1.8 million and $2.7 million. In June, MMAJ also signed a $2.4 millon agreement with Zambia Consolidated Copper Mines for exploration of cobalt and copper in the Chambidishi area, about 30 km^2, in the copper belt province beginning in August.

In August, MMAJ signed an agreement with the Government of Namibia to conduct a 2-year detailed geological and geochemical survey in the Marinkas Quelle and Osongombo areas in central Namibia for rare-earth minerals beginning in October.

In September, MMAJ also signed a $3 million agreement with Chile's state-owned mining company, Empresa Nacional de Mineria, for exploration of copper in the Veraguas area, about 60 km^2, and in the Progreso area, about 10 km^2, east of Copiapo for 3 years beginning in October 1993.

The Government also is to provide financial and technical assistance to China, Kazakhstan, and Kyrgyzstan. MITI reportedly will provide and develop technology in cooperation with the Chinese Government for mine drainage treatment over a 6-year period beginning in 1993. According to MITI, mine drainage containing high levels of zinc and mercury, which is being discharged into rivers without any form of treatment, has caused serious water pollution problems in China. The Japan International Cooperation Agency reportedly is to provide technical assistance through MMAJ to Kazakhstan and Kyrgyzstan in Central Asia for mine develop projects of copper, gold, lead, titanium, and zinc. The Government of Japan is to provide funding for technical assistance to these two countries.

In fiscal year 1993, Japan continued to build its rare metals stockpile of chromium (in ferrochromium), cobalt (in metal), manganese (in ferromanganese), molybdenum (in concentrate), nickel (in metal, ferronickel, and nickel oxide), tungsten (in concentrate), and vanadium (in concentrate) under two-scheme programs. According to MMAJ, the administrator of the Government program, the stockpile of the seven metals by the Government program will reach 33.9 days of supply and the private program will reach 14.5 days of supply by the fiscal year ending March 1994. In the process of reviewing the adequacy of the existing program, antimony, palladium, and rare earths reportedly had been discussed to be added to the existing seven rare metals by MITI's Mining Industry Council because of few available overseas supplying sources.

After more than 3 years of the Uruguay Round of multilateral negotiations of the General Agreement on Tariff and Trade (GATT), the Government of Japan, according to local press reports, will offer to cut the tariff rate on 6,500 items in the mining and manufacturing sectors by an average of 60%, compared with offering a 50% cut in 1992. Tariffs on nonferrous metals, such as refined copper, lead, and zinc, will be cut in half to 3%.[4] According to MITI, the present temporary tariff on refined copper, lead, and zinc is 15 yen per kilogram (kg), 8 yen per kg, and 8 yen per kg, or equivalent to 4.6.%, 8.9%, and 5.6% ad valorem, respectively, according to MITI. Japan's offer in 1993 to cut the tariff rate on all nonferrous metals by 50% to 3% by 1999, which is to be reduced in 5 years beginning in July 1995, along with other industrial and

agricultural products, is expected to be ratified at the signing of the GATT Uruguay Round on April 15, 1994.

ENVIRONMENTAL ISSUES

To set the foundation for environmental policy, to be able to take broader measures toward sustainable development, and to incorporate the concept of global environmental protection into existing laws on pollution prevention and natural environment conservation, the Government of Japan enacted the country's Basic Environmental Law on December 19, 1993. The bill was first approved in June 1993 by the Lower House of the Japanese Diet or Parliament, and later approved by the Upper House in November 1993.

According to local press reports, the 46-article legislation mandates the Government to set up prevention of global warming and acid rain, requires the Government to develop a long-term perspective for reducing the adverse environmental impacts on social and economic activities, and urges cooperation of the Government and the business community to review the wasteful social system. It also encourages the Government to consider introducing an environmental tax. However, it fails to mandate the Government to enforce the requirement of environmental impact assessments for development projects.[5]

Before passage of the comprehensive Basic Environment Law in November, under the Environmental Pollution Control Act of 1967, the Air Pollution Control Law was enacted in 1968 to regulate air emission. The Water Pollution Control Law and Marine Pollution Control Law were both enacted in 1970 to regulate wastewater discharges. The Waste Management Law also was enacted in 1970 to regulate solid and hazardous waste. The Law for the Promotion of the Use of Recyclable Resources was enacted in 1991 to promote public awareness and the use of recycled materials. Other legal provisions related directly to mining included the Mining Law, the Mining Safety Law, and Metal Mine Safety Rule.

The Environmental Agency (EA) and MITI are two principal regulatory agencies for environmental preservation, planning, policy development, and standards of air quality, water quality, and disposal of hazardous waste. The Ministry of Health and Welfare participates in the development of standards of disposal of hazardous waste and regulates waste collection and handling. The Ministry of Transportation helps EA and MITI to develop standards for oil discharges from ships, and the Science and Technology Agency regulates radioactive waste. However, the issue of permits and enforcement of environmental laws were the responsibilities of the local prefectural and municipal governments, which also have the power to establish more stringent requirements and standards.[6]

In March, Japan's EA revised and raised the environmental standards of effluent. According to a report by the Central Pollution Control Council, under the Water Pollution Prevention Act of 1971, only eight toxic substances of effluent quality standards were listed initially. Between 1975 and 1989, three additional items had been added. Under the newly revised standards, 13 additional items had been added as toxic substances, while standards of effluent also had been raised to 10 times higher than that of the environmental standards of receiving-water, such as river and ocean. Under the EA's new standard of effluent, the limit of mercury compounds is 0.005 mg/L or less; the limit of arsenic and its compounds, cadmium and its compounds, lead and its compounds, and selenium is 0.1 mg/L; and the limit of hexavalent chromium compounds is 0.5 mg/L.

However, a lower temporary standard is to be used for some toxic substances of effluent for designated industries, if the standards of effluent are difficult to achieve owing to lack of technology. For example, the temporary standard of arsenic and its compounds and lead and its compounds, for the metal mining industry is 0.3 mg/L or less, and 0.7 mg/L or less, respectively. The temporary standard of arsenic and its compounds, lead and its compounds, and selenium for the copper smelting industry is 0.4 mg/L, 0.5 mg/L, and 1.5 mg/L, respectively.

According to local press reports, an organization called Mineral Resource Environmental Center (MREC) was established in 1993 by the mining industry with the participation of MITI in planning and partial funding to utilize the closed mines for metals recycling and processing of industrial waste at the mine sites. Under the plan, nonferrous metals, such as copper, gold, lead, mercury, sliver, and zinc, will be extracted from industrial waste, while the remaining waste will be used as filler to the mine to prevent ground sinking.

As part of MITI's 10-year Research and Development Project of Industrial Technologies for Global Environment with a total budget of $90 million, the New Energy Development Organization (NEDO) is to launch R&D projects on new technology to promote recycling of nonferrous metals from scrap materials, such as cans, sashes, appliances, and scrap automobiles. The technology reportedly is to focus on separation of copper, rare metals, and zinc from scrap and on refining these recycled metals with the aim of global environmental preservation and energy saving. The first-year budget will be about $1.35 million, followed by a second-year budget of $7.15 million. NEDO is a Tokyo-based semi-Government agency.

PRODUCTION

Mine production of most nonferrous minerals, except gold, decreased considerably from that of 1992 because of a higher yen value and increased low-priced imports of nonferrous metal ore and concentrate. Increased gold production was due mainly to increased ore output from the Hishikari Mine and from the nearby Yamada gold deposit in Kagoshima Prefecture of southern Kyushu. Mine production of most industrial minerals and construction-related materials, except silica sand and feldspar, decreased from that of 1992 owing to the continued slowdown in construction activity resulting from a weakened economy in 1993.

In the mineral fuels sector, coal output

dropped to a record low in 1993 because of further cutbacks in production of the Hokkaido coal mines. Production of natural gas continued the 1992 upward trend, while production of crude petroleum decreased in 1993.

In the mineral processing sector, production of most metals and industrial minerals was at a lower level than that of 1992 because of further decline in demand for basic materials by the automobile and construction industries in 1993. However, metal production of copper, gold, and high-purity silicon was at a slightly higher level in 1993. *(See table 1.)*

TRADE

Japan was a major world importer of energy, nonfuel minerals, and nonferrous metals and remained a major world exporter of processed minerals in 1993. As a result of lower import bills and higher export earnings, Japan's mineral trade deficit was smaller than that of 1992. The lower import bills of mineral fuels were due to the higher yen value and lower world prices of nonferrous minerals, coal, and oil in 1993, while higher export earnings were due to an increased export volume of iron and steel products and nonferrous metals in 1993.

Despite increased imports of mineral fuels, including coal, crude and partially refined petroleum, LNG, and refined petroleum products, the total import bill of mineral fuels declined from $52.7 billion in 1992 to $48.8 billion, accounting for 20.3% of total imports in 1993. Despite a slight increase in the import volume of minerals ores, nonferrous metals, and metal scrap, total import bills of nonfuel minerals dropped from $18.4 billion in 1992 to $17.7 billion, accounting for 7.4% of total imports in 1993.

Total exports of minerals commodities, including iron and steel, nonferrous metals, and industrial minerals, increased from $25.2 billion in 1992 to $27 billion, accounting for 7.5% of total exports in 1993. Exports of iron and steel rose to $14.5 billion from $13.3 billion in 1992 owing mainly to increased exports to China. Exports of nonferrous metals, fabricated metal products, and industrial minerals also increased to $12.4 billion from $11.9 billion in 1992.

The United States remained the most important trade partner of Japan because of its significant role in supplying Japan with a wide variety of raw materials, foodstuffs, and manufactured products. In overall merchandise trade, Japan's exports to the United State rose from $95.8 billion in 1992 to $105.4 billion, accounting for 29% of Japan's total exports in 1993. Imports from the United States also rose from $52.2 billion in 1992 to $55.2 billion, accounting for 23% of Japan's total imports in 1993. In 1992, Japan's overall merchandise trade surplus with the United States rose from $43.6 billion in 1992 to $50.2 billion. *(See tables 2 and 3.)*

STRUCTURE OF THE MINERAL INDUSTRY

In terms of the number of establishments, employment, and gross value of production, Japan's mineral industry consisted of a small nonferrous metal mining sector, a small-size coal mining sector, a large industrial minerals mining sector, and a large world-class ferrous and nonferrous minerals processing sector. Mining and mineral processing businesses are owned and operated by private companies incorporated in Japan. The Government extends financial and technical assistance to the mineral industry, which follows Government policy guidelines during depressed market conditions.

Because of the restructuring program resulting from the depressed market conditions domestically and internationally in the 1980's, industry output capacity and employment had been reduced considerably. Contraction in coal, nonferrous metal mining, iron and steel, fertilizer materials, and cement was more drastic than in other sectors because of the appreciation of the yen, higher domestic production costs, and lower prices of import mineral and metal products.

According to MITI, coal was produced from 5 large-scale major mines and 11 small-scale mines mainly in the Hokkaido and Kyushu areas with a total capacity of about 8 Mmt/a and a work force of 3,700 in 1993. The number of operating nonferrous metal mines was reduced to 24 from 26 in 1992, and employment declined from 2,198 in 1992 to 1,863 in 1993. The number of operating industrial minerals mines and employment both declined from 578 and 13,235 in 1992 to 577 and 12,951, respectively, in 1993.

In line with the overall industrial restructuring program, the steel industry, with an excess of workers, cut its work force to 287,068 from 291,625 in 1992. The iron and steel industry also reduced its pig iron production capacity to 97.6 Mmt/a in 1993 from 99 Mmt/a in 1992 and its steelmaking capacity to 137.9 Mmt/a in 1993 from 140.3 Mmt/a in 1992. Because of the continued growth in demand for copper and zinc in the Far East region, the nonferrous metal smelting and refining industry continued expanding its capacity of copper and zinc in 1993.

According to MITI, Japan's copper refining capacity was raised to 1,280,400 mt/a from 1,262,400 mt/a in 1992. Japan's lead refining capacity remained at 327,000 mt/a in 1993, while zinc refining capacity was raised to 885,240 mt/a from 874,440 mt/a in 1992. *(See table 4.)*

According to the Statistics Bureau of Japan's Management and Coordination Agency, the number of persons employed by the mining industry in 1993 remained at about 60,000, accounting for 0.09% of the Japanese labor force of 66.1 million compared with 80,000 persons accounting for 0.14% of 60.8 million in 1987.

COMMODITY REVIEW

Metals

Aluminum.—Production of primary aluminum by Nippon Light Metal Co. Ltd. at its Kanbara plant in Shizuoka Prefecture declined to a record low and remained insignificant in 1993. Since the

mid-1980's, Japan had been dependent on primary aluminum imports to meet virtually all of its annual primary aluminum requirement. Japan was the world's largest importer of primary aluminum, accounting for about 30% of the primary aluminum traded in the world market, and was the world's second largest consumer of primary aluminum in 1993. Despite reduced demand by major rolling companies in 1993, imports of primary aluminum increased from 2.25 Mmt to 2.27 Mmt (in metal content of primary aluminum and alloy ingots). As a result, the yearend overall stocks of primary aluminum by producers, dealers, and consumers increased to 382,332 tons in 1993 from 273,322 tons in 1992.

According to the Ministry of Finance, imports of primary aluminum were 2,604,352 tons in 1993, of which 123,332 tons was high-grade ingot, 1,803,097 tons was regular-grade ingot, and 677,923 tons was alloy ingot. Because of its heavy reliance on imports, Japan had widely diversified its overseas sources of primary aluminum into more than 50 countries. About 67% of Japan's primary aluminum imports in 1993 was from seven major primary aluminum-producing countries, including Australia, Brazil, Canada, Indonesia, New Zealand, the United States, and Venezuela, where Japan's overseas aluminum smelting operations are located. However, Russia had become an important supplier of primary aluminum to Japan in 1993. Australia was the top supplier, accounting for 14.9% of Japan's total primary aluminum imports in 1993, followed by Brazil, 14.1%; the United States, 12.5%; Russia, 12.3%; Venezuela, 7%; Canada, 6.8%; New Zealand, 6.1%; Indonesia, 5.2%; and Bahrain, 4.8%.

Consumption of primary aluminum declined by 5.6% to 2.2 Mmt in 1992 and again by 6.2% to 2.1 Mmt in 1993 because of reduced demand in all consuming sectors, especially for aluminum rolling, which was effected by a further slowdown in the manufacture of automobiles, aluminum cans, building materials, and home electric appliances in 1993. According to MITI, consumption of primary aluminum, by sector, in 1991-93 is shown in table 5. *(See table 5.)*

Cadmium.—Japan was the world largest cadmium producer and consumer. Despite the continued growth in domestic demand for cadmium, production of cadmium declined in 1993 owing to the reduced production of zinc metal. According to the Japan Mining Industry Association (JMIA), production of cadmium was by Dowa Mining Co. Ltd., accounting for 14% of total output; Mitsubishi Materials Corp., 14%; Mitsui Mining and Smelting Co. Ltd., 17%; Nippon Mining & Metal Co. Ltd. (formerly Nippon Mining), 19%; Sumitomo Metal Mining Co. Ltd., 9%; and Toho Zinc Co. Ltd., 27%. These companies owned and operated zinc refineries, which produced cadmium as a byproduct. Japan's raw material requirements for production of cadmium was about 78% dependent on imported zinc ore from Australia, Canada, Peru, and the United States.

Imports of cadmium metal increased by 9.1% to 3,018 tons in 1993. The major suppliers of cadmium metal were Belgium, 840 tons; Canada, 525 tons; Australia, 372 tons; Thailand, 335 tons; Peru, 211 tons; and the Republic of Korea, 169 tons. These six countries accounted for 81% of Japan's cadmium imports in 1993. The average import c.i.f. price of unwrought cadmium was $0.45 per pound in 1993 compared with $1.10 per pound in 1992, $1.78 per pound in 1991, and $3.80 per pound in 1990. Exports of cadmium increased from 22 tons in 1992 to 41 tons, of which 24 tons went to the Republic of Korea and 17 tons to China.

Domestic demand for cadmium increased by 4.6% to 2,903 tons in 1993 owing mainly to a strong growth in the batteries and pigments sectors. According to JMIA, domestic demand by sector in 1993 was as follows: 2,398 tons was consumed for the manufacture of nickel-cadmium batteries, 160 tons was for pigments, 83 tons was for nonferrous alloys, 14 tons was for stabilizers, and the remaining 248 tons was for plating and other uses.

Consumption of cadmium for the manufacture of nickel-cadmium batteries had increased from 1,760 tons in 1987 to 2,398 tons in 1993. In past years, most of the nickel-cadmium batteries in Japan was used for railroad crossing signals, toys, video cassette recorders, cordless telephones, and more recently for portable personal computers and cellular car telephones. The batteries industry was expecting an upsurge in the application of nickel-cadmium batteries for electric cars in the next few years.

MITI began implementing its recycling regulations for nickel-cadmium batteries to mitigate the possible adverse environmental effects of the batteries. Beginning in May, manufacturers, packers, and importers of nickel-cadmium batteries are required to print and label these products with appropriate recycling symbols to distinguish their products from other batteries. According to MITI, before a $4,500 fine on companies that did not abide by the regulations will be enforced, there will be a 2-year transition period.[7] Currently, the large industrial rechargeable cadmium-nickel batteries were recycled by Toho Zinc at its Annaka zinc refinery in Gumma Prefecture. Hikoshima Smelting Co. Ltd. also operated a 240-mt/a recycling plant at its zinc refining complex at Hikoshima near Shimonoseki in Yamaguchi Prefecture. The recycling plant reportedly recovered about 150 mt/a of cadmium. However, all of the scrap materials feeding the plant were imported from the United States.

Chromium.—Chromium ore concentrate produced by Nippon Chrome Industries Ltd. from the Wakamatsu Mine in Tottori Prefecture was estimated to be about 7,000 tons in 1993. Japan relied on imports to meet almost all of its chromium requirements in 1993.

Imports of metallurgical- and refractory-grade chromite declined by 17% to 601,629 tons in 1993. The Republic of South Africa and Kazakhstan were two dominant suppliers of chromite, providing 361,760 tons and 111,061 tons, respectively, in 1993. Other important suppliers of chromite were Madagascar, 47,725 tons; India, 38,214 tons; Russia, 26,502 tons; and Iran, 12,024 tons.

According to MITI, consumption of chromite by the ferroalloy industry decreased from 548,236 tons in 1992 to 428,026 tons in 1993. Ferrochromium was produced by five companies in 1993. Japan Metal and Chemical Co. Ltd. operated a 87,000-mt/a-capacity plant at Kita Kyushu in Fukuoka Prefecture and a 21,000-mt/a- capacity plant at Oguni in Yamagata Prefecture. NKK Corp. operated a 60,000-mt/a-capacity plant at Toyama in Toyama Prefecture. Nippon Denko K.K. operated a 100,000-mt/a-capacity plant at Hokuriku in Toyama Prefecture. Pacific Metals Co. Ltd. operated a 27,000-mt/a-capacity plant at Hachinohe in Aomori Prefecture. Showa Denko K.K. operated a 20,700-mt/a-capacity plant at Chichibu in Saitama Prefecture and a 55,000-mt/a- capacity plant at Shunan in Yamaguchi Prefecture.

In 1993, imports of ferrochromium increased to 548,917 tons from 459,608 tons in 1992 because of reduced domestic production of ferrochromium. The Republic of South Africa remained the dominant supplier of ferrochromium, providing 264,028 tons or 48% of the 1993 ferrochromium imports. Other important suppliers in 1993 were China, 79,603 tons; India, 69,727 tons; Zimbabwe, 42,107 tons; the Philippines, 21,670 tons; Russia, 15,451 tons; Finland, 13,987 tons; and Kazakhstan, 10,148 tons. In 1993, China became an important source of high-carbon ferrochromium because of low prices, which help Japan's stainless steel producers cut their production cost for export-oriented specialty steels.

In an effort to secure a long-term supply of ferrchromium, Nippon Denko, Japan's second largest ferrochromium producer, and Samancor Ltd. of the Republic of South Africa signed an agreement in September to establish a joint-venture firm for the production of ferrochromium in South Africa for export to Japan. Under the agreement, NST Ferrochrome Pty Ltd., a 50-50 joint-venture firm, was established with an equity capital of about $33 million. NST Ferrochrome had taken over and began operation of Samancor's No. 5 furnace at Tubatse in late October for production of ferrochromium with an annual capacity of 60,000 mt/a using ore produced from nearby Samancor mines. Nippon Denko, which is to import all of ferrochromium production from the Tubatse plant, is expected to shut down and cease production of its No. 73 furnace at its Hokuriku plant in Toyama Prefecture.[8]

Consumption of ferrochromium declined from 719,560 tons in 1992 to 709,521 tons in 1993, of which 667,341 tons was high-carbon ferrochromium and 42,180 tons was low-carbon chromium.

Japan remained the world's leading producer of chromium metal in 1993. Production of chromium metal with 99.95% purity declined to about 3,000 tons from 3,720 tons in 1992 because of lower domestic prices. Nippon Denko K.K. operated a 700-mt/a plant using the aluminothermic process at Tokushima in Tokushima Prefecture. Tosoh Corp. operated a 3,600-mt/a plant using the electrolytic process at Yamagata in Yamagata Prefecture. About 90% of chromium metal production in 1993 was by Tosoh. Because of further yen appreciation, which makes the Japanese producers less competitive, and the redevelopment program of Yamagata City, where the Tosoh chromium metal plant is located, the company had decided to close the plant in 1995. In 1992, Tosoh conducted a joint feasibility study with Samancor of the Republic of South Africa for construction of a 3,600-mt/a chromium metal plant in South Africa using Tosoh's technology. However, the two companies were unable to reach an agreement and decided to terminate negotiations in September.

In 1993, imports of chromium metal rose 48% to 1,468 tons and for the first time, Japan's imports of chromium metal had exceed exports. Imports from China rose from 140 tons in 1991 to 651 tons in 1993 and imports from Russia also rose from 34 tons in 1991 to 245 tons in 1993. Other suppliers of chromium metal in 1993 were France, 209 tons; the United Kingdom, 215 tons; and the United States, 147 tons. According to a Japanese industry source, domestic demand for chromium metal decreased from 1,220 tons in 1992 to about 750 tons in 1993, of which 45% was for superalloys, 28% for welding rods, 20% for nonferrous alloys, and 7% for other uses. Japanese exports of chromium metal dropped sharply from 2,315 tons in 1992 to 1,336 tons in 1993 owing to further appreciation of the Japanese yen.

Cobalt.—Japan relied on imports to meet all of its cobalt requirements. Cobalt metal production rebounded to the 1991 level. Since 1987, Sumitomo Metal Mining Co. Ltd., the sole cobalt metal producer with a rated capacity of 1,600 mt/a, has recovered cobalt from the precipitate of its nickel refinery in Niihama, Ehime Prefecture, using cobalt-bearing nickel sulfide from Australia and Indonesia. Nippon Mining's Nikko cobalt-nickel refinery with a rated capacity of 1,200 mt/a in Hitachi, Ibaraki Prefecture, remained shut down owing to a lack of raw material.

Imports of cobalt metal increased slightly to about 4,500 tons in 1993 as cobalt prices in the world market decreased. Imports of cobalt metal, including powders, flakes, and waste and scrap, were 4,500 tons in 1993. Zaire remained the dominant supplier, providing 1,405 tons. Other important cobalt metal suppliers in 1993 were Belgium, 890 tons (mostly in cobalt powder and cobalt oxides); Norway, 701 tons; Zambia, 498 tons; Canada, 332 tons; and the United Kingdom, 131 tons. In 1993, Japan's exports of cobalt, including matte, intermediate products, and scrap were 268 tons, compared with 264 tons in 1992.

According to MITI, demand by the manufacturers of catalysts; magnetic materials; pipe, plate, and rods; and specialty steel all increased considerably in 1993 because of lower cobalt prices. Demand for catalysts, according to an industry source, is expected to enjoy further growth as Japan's investment in pollution prevention facilities increase. Demand by the manufacturers of cemented carbide continued its 1992 downward trend, reflecting the slowdown in general economic activity in Japan. Consumption of cobalt by end use is shown in table 6. *(See table 6).*

Copper, Lead, and Zinc.—In 1993, domestic mine production of copper, lead, and zinc was at a much lower level than that of 1992. As a result, Japan imported more ore and concentrate of copper and lead in 1993 to meet its nonferrous metal smelting requirements. The amount of domestic mine production of copper, lead, and zinc was equivalent to 0.9%, 6.3%, and 17.0%, respectively, of Japan's ore requirements for metal production of copper, lead, and zinc in 1993. According to MITI, as of April 1993, there were only 3 major operating nonferrous metal mining companies with more than 100 workers and 1 small-scale operating nonferrous metal mining company with 49 workers.

Hanaoka Mining Co. Ltd., which operated two underground mines at Fukasawa, and Matsumine in Akita Prefecture with 288 workers, produced 4,508 tons of lead and 27,722 tons of zinc (metal content of the concentrate) in 1992. The Kamioka Mining Co. Ltd., which operated two underground mines at Kamioka-Mozumi and Kamioka-Tochibora in Gifu Prefecture with 716 workers, produced 3,368 tons of lead and 45,284 tons of zinc in 1992. Toyoha Mining Co. Ltd., which operated an underground mine at Toyoha in Hokkaido Prefecture with 351 workers, produced 7,850 tons of lead and 55,164 tons of zinc in 1992. Shin-Uchinotai Mining Co. Ltd., a lead and zinc producer, operated an underground mine at Nurukawa in Aomori Prefecture with 49 workers.

The Kamaishi Mine, Japan's only copper mine in Iwate Prefecture, was closed in the spring of 1993 owing to the appreciation of the Japanese yen, lower domestic metal prices, and depletion of ore reserves. For the same reasons, Dowa Mining Co. Ltd. announced in November that it would close three nonferrous metal mines owned and operated by two of its wholly owned subsidiaries. As a result of the action, Dowa Mining would cease all of its domestic metal mining operations and would reassign about 200 of its workers at the mines to the company's recycling operations.[9]

The three nonferrous mines that were scheduled for closing at the end of March 1994 are the Matsumine Mine and the Fukazawa Mine, north of Odate in Akita Prefecture, owned and operated by the Hanaoka Mining Co. Ltd. and the Nurukawa Mine, northwest of Towada Lake in Aomori Prefecture, owned and operated by the New Uchinotai Mining Co. Ltd. The Matsumine and Fukazawa Mines combined were capable of producing 5,000 mt/a of copper, 4,000 mt/a of lead, and 20,000 mt/a of zinc. The Nurukawa Mine was capable of producing about 2,000 mt/a of lead and 4,000 mt/a of zinc.

In domestic exploration, MMAJ continued its exploration at the Jozankei area, west of Sapporo, Hokkaido, where a promising lead-zinc-silver deposit had been discovered. According to MMAJ, in December, a contact metasomatic deposit with a core length of 44 m assaying 13% zinc was discovered at Kamioka-cho in Gifu Prefecture. MMAJ is to continue exploration, such as boring in the area in 1994.

In overseas exploration and development, according to the Japanese industry sources, six major nonferrous metal mining companies were involved in joint development of copper, lead, and zinc mines with foreign partners in Australia, Chile, and Mexico in 1993. Furukawa Co. Ltd., through ownership of Denehurst Ltd. of Australia, completed joint development of the Benambra copper mine in northeastern Victoria with Macquarie Resources Ltd. of Australia. The project was officially opened in December 1992. Proven and probable reserves at the Benambra Mine were estimated at 710,000 tons grading 8.63% copper, and 2.93% zinc.

Nippon Mining & Metal Co. Ltd., Mitsui & Co. Ltd., Mitsubishi Materials Corp., and Marubeni Corp. began joint development of the McArthur River zinc-lead-silver project with Mount Isa Mines Ltd. of Australia in the Northern Territory. The McArthur River deposit has proven and probable reserves of 26 Mmt with an average ore grade of 14% zinc and 6.3% lead plus 63 g/mt of silver. The $170 million project is jointly owned by MIM, the parent company of Mount Isa Mine, 70%; Nippon Mining and Metal, 15%; and Mitsui, Mitsubishi, and Marubeni, 5% each. Construction of mine and milling facilities was scheduled for completion in 1995 with an annual capacity of 1.5 Mmt of ore and 350,000 mt/a of mixed concentrate containing 160,000 tons of zinc, 45,000 tons of lead, and 49,800 kg of silver.

Sumitomo Metal Mining Co. Ltd. and Sumitomo Corp. began joint development of the Northparkes copper-gold project in New South Wales, Australia, with North Broken Hill Peko Ltd. in April. The Northparkes deposit, about 300 km northwest of Sydney, has ore reserves of more than 68 Mmt grading 1.26% copper plus 0.65 g/mt of gold. The $173 million project is jointly owned by North Broken Hill Peko, 80%, and Summitomo Metal Mining and Sumitomo Corp., 20%. Construction of mine and milling facilities began in April 1993 and was scheduled for completion in September 1995. The ores will be produced from two open pits and one underground mine. The milling capacity will be 3.7 Mmt/a for producing 100,000 mt/a of concentrate containing 45,000 tons of copper.

In Chile, Sumitomo Metal Mining and Sumitomo Corp. began joint development of the La Candelaria copper project with Phelps Dodge Corp. of the United States. La Candelaria copper deposit has 399 Mmt of reserves averaging 1.06% copper plus 0.25 g/mt of gold. The $559 million project is jointly owned by Phelps Dodge, 80%; Sumitomo Metal Mining, 15%; and Sumitomo Corp., 5%. The mine is expected to come on-stream in January 1995 with an annual output of 8.5 Mmt/a of ore and 336,000 mt/a of copper concentrate. In July, Itochu Co. Ltd. and Nitetsu Mining Co. Ltd. of Japan reportedly agreed to invest between $5 million and $10 million in a joint-venture project with Inversiones Errazuriz to develop the El Bronce copper deposit in northern Chile. The $40 million copper project, which needs an additional $30 million financing, would have an annual capacity to produce 25,000 mt/a of copper.[10]

In Mexico, Dowa Mining Co. Ltd. and Sumitomo Corp. began joint development

of a complex (copper, lead, and zinc) sulfide ore deposit with Industria Penoles of Mexico at Tizapa in the Arceris district, about 260 km west of Mexico City. The ore deposit, discovered by the Metal Mining Agency of Japan in 1987, has proven reserves of 4 Mmt averaging 6.99% zinc, 1.64% lead, and 0.55% copper plus 1.67 g/mt of gold and 288 g/mt of silver. The $38.2 million project is owned by Industria Penoles, 51%; Dowa Mining, 39%; and Sumitomo Corp., 10%. Ore production was scheduled to begin in May 1994 at the rate of 240,000 mt/a. The mill output will be 27,600 mt/a of zinc concentrate and 10,800 mt/a of copper concentrate.

Japan remained the world's largest importer of copper ore and concentrate accounting for more than 47% of the world total in 1993. As a result of expanded copper smelting and refining capacities and decreased domestic mine production, imports of copper concentrate, blister, and unalloyed copper scrap all increased. However, imports of refined copper decreased in 1993 owing to reduced domestic demand for refined copper by the manufacturers of wire and cable resulting from the continued economic slowdown in 1993. *(See table 7 and figure 1).*

Because of reduced domestic mine production, imports of lead ore and concentrate increased by 7.6% to 290,706 tons in 1993, of which 101,059 tons came from Australia, 69,528 tons from Peru, 56,038 tons from the United States, 26,242 tons from Canada, 15,027 tons from the Republic of South Africa, 7,728 tons from China, 7,000 tons from Iran, and 8,084 tons from other countries. Imports of zinc ore and concentrate dropped 4.2% to 1,180,060 tons in 1993, of which 687,458 tons came from Australia, 189,718 tons from Peru, 127,815 tons from the United States, 49,521 tons from Mexico, 48,210 tons from Chile, 38,113 tons from Canada, 15,465 tons from Bolivia, 15,278 tons from China, and 9,482 tons from Russia. The United States dropped from the second to the third largest supplier, accounting for 10.8% of Japan's zinc concentrate imports in 1993. *(See table 8.)*

Imports of refined lead dropped sharply by 17.6% to 42,138 tons, while imports of slab zinc also dropped by 20.4% to 84,248 tons in 1993. The suppliers of refined lead in 1993 were Mexico, 12,339 tons; Peru, 7,961 tons; China, 7,342 tons; Australia, 7,134 tons; the United States, 5,195 tons; and other countries, 2,167 tons. The major suppliers of slab zinc were North Korea, 24,309 tons; the Republic of Korea, 17,801 tons; China, 10,764 tons; Australia, 8,532 tons; Canada, 7,427 tons, Kazakhstan, 5,507 tons, Peru, 2,180 tons; Zaire, 1,712 tons; Mexico, 1,642 tons; Uzbekistan, 1,518 tons; and other countries, 2,856 tons.

Despite a weak domestic demand, metal production of copper continued to increase in 1993 because of reduced imports of refined copper and increased exports of refined copper to Taiwan and China, where the growth in demand for copper had been very strong for the past years. Metal production of lead and zinc decreased owing to reduced domestic demand for refined lead and slab zinc in all consuming sectors, as the economy slowed further in 1993. However, Japan continued to modernize and expand its zinc refining capacity in 1993, but it is to reduce its lead refining capacity in 1994.

Kamioka Mining Co., a wholly owned subsidiary of Mitsui Mining and Smelting Co. Ltd., completed the $55 million renovation project of its zinc refinery at Kamioka in Gifu Prefecture in March and began commercial operation in April. The 50-year-old existing 72,000-mt/a plant next to the new refinery will be scrapped. According to Mitsui Mining and Smelting, the new zinc refinery with a design capacity of 72,000-mt/a, which used Super Jumbo Technology of Union Miniere and was equipped with an automatic ceiling crane, had cut electric power consumption by 9% and reduced the number of workers from 56 to 19. However, the company decided to partially cease ore production of lead and zinc in the Mozumi area of the Kamioka Mine and planned to stop primary lead refining at the Kamioka nonferrous metal mining and smelting complex in Gifu Prefecture at the end of 1994.

Mitsubishi Materials Corp., which had expanded copper refining capacity of its Naoshima complex in Kagawa Prefecture, announced in December that it will close its Naoshima lead refinery at the end of March 1994. The reasons cited by the company for withdrawing from the lead refining business were the poor outlook for the domestic demand for lead by the storage battery industry, a sharp drop in the lead price, the appreciation of the Japanese yen, and the Government plan to reduce tariffs on refined nonferrous metals beginning in 1996.

In connection with the McArthur River lead-silver-zinc development project, Nippon Mining, Mitsui Mining & Smelting Co., and Australia's MIM Holdings established a joint-venture firm called Pacific Zinc Corp. (PZC) in August 1992. The joint-venture firm, which originally scheduled to begin construction of the $375 million lead-zinc smelting and refining plant in early 1994 in Hachinohe, Aomori Prefecture, was postponed indefinitely because of low prices of lead and zinc and the appreciation of the Japanese yen, resulting in a higher construction cost and lower revenues.[11]

Domestic consumption for refined copper continued the 1992 downward trend and dropped by 2.4% to 1,480,216 tons in 1993 because of reduced demand for the manufacture of electric wire and cable. Demand for copper by the wire and cable sector, which accounted for 67.4% of copper consumption in 1993, dropped 3.9% to 997,561 tons owing to the further slowdown in the construction and electric power industries. However, demand for copper by the brass mill sector, which accounted for 31.3% of copper consumption in 1993, rose by 1.5% to 462,683 tons mainly owing to increased demand by the electrical machinery and metal products producers. Exports of refined copper continued the 1992 upward trend and reached 159,217 tons in 1993. The major overseas buyers were Taiwan, accounting for 49.5% of total exports; China, 22.7%; the Republic of Korea, 12.1%; and Thailand, 6.4%. Overall stocks of refined copper rose by

5.4% to 158,525 tons at the end of 1993.

Domestic demand for refined lead decreased by 7.9% to 282,735 tons in 1993, of which 63.7% was for storage batteries, 20.9% for inorganic chemicals, 3.7% for solders, 3.3% for lead pipe and sheet, and 8.4% for other. Exports of primary lead rose sharply from 3,557 tons in 1992 to 7,175 tons in 1993. Overall stocks of primary lead decreased by 7.2% to 37,836 tons at the end of 1993.

Domestic demand for zinc slab also continued the 1992 downward trend and dropped by 8.2% to 717,504 tons in 1993, of which 49.5% was for sheet galvanizing, 14% for other plating, 13.5% for brass mill products, 12.3% for zinc die cast, 4.2% for inorganic chemicals, and 6.5% for other. Exports of zinc metal increased by 7.8% to 32,467 tons in 1993. Overall stocks of zinc slab rose by 24.2% to 147,551 tons at the end of 1993.

Gold and Silver.—Mine production of gold reached its highest level in 6 years and that of silver reversed its 4-year upward trend and dropped sharply by 23% in 1993. Gold mine production by Sumitomo Metal Mining from the Hishikari Mine and the nearby Yamada deposit in Kagoshima Prefecture of southern Kyushu contributed most to the overall increase in gold mine production in 1993. Development of new ore bodies at the Yamada and the Yamagami deposits in the vicinity of the Hishikari Mine had been completed by Sumitomo Metal Mining. The planned ore production in 1993 was 150,000 tons with an average ore grade of about 53 g/mt of gold. According to MITI, mine production of gold from the Hishikari Mine by Sumitomo Metal Mining rose to 7,897 kg in 1992 from 7,246 kg in 1991 and mine production of silver rose to 3,957 kg in 1992 from 3,927 kg in 1991.

In addition to the Hishikari Mine, there were six small-scale gold mining companies operated mostly in Kagoshima Prefecture in 1993. Because of low domestic metals prices, silver mine production, mainly by Toyoha Mining Co. Ltd. from the Toyoha Mine, a major lead-zinc-silver mine in Hokkaido, declined considerably in 1993.

In domestic gold exploration, Sumitomo Metal Mining and MMAJ were conducting joint exploration for gold and silver in the Ohtohge area of Yamagata Prefecture, near the border of Fukushima Prefecture, where mineralization of gold and silver was found by MMAJ and Sumitomo Metal Mining in six locations in the past year. In April, Dowa Mining announced that it had discovered gold-bearing quartz veins in the Harukawayama area, a suburb of Sapporo in Hokkaido. Samples obtained from boring operations show grading between 10 g/mt and 30 g/mt of gold contained in fine quartzite veins about 300 m below surface. Dowa Mining will continue exploration in its mining concession area near Mount Haruka.

In December 1993, MMAJ announced that it had discovered Japan's largest gold veins at Kamishihoro-cho, near Sumitomo Metal Mining's abandoned Konoike gold mine, in northeastern Hokkaido. According to MMAJ's preliminary boring test, two small veins were discovered at the site designated as 5MAHB-2. One vein discovered at depths of between 314.8 m and 326.8 m with a width of 12 m contained 9.37 g/mt of gold. Another discovered at depths of between 327.8 m and 332.3 m with a width of 4.5 m contained 7.15 g/mt of gold. The veins measured, between 4 m to 12 m wide, are considered relatively large when compared with common veins that vary from 1 m to several meters wide. MMAJ is to continue further exploration and investigation to assess the scale of the deposit.

Japan's production of gold metal increased while that of silver metal decreased in 1993. There were five metal producers of gold and silver in 1993. Dowa Mining's metal production was at its Kosaka precious-metals refinery in Akita Prefecture. Mitsubishi Materials' metal production was at its Naoshima precious-metals refinery in Kagawa Prefecture. Mitsui Mining and Smelting's metal production was at its Takehara precious-metals refinery in Hiroshima Prefecture. Nippon Mining's metal production was at its Saganoseki precious-metals refinery in Oita Prefecture. Sumitomo Metal Mining's metal production was at its Toyo smelting and refining facilities in Niihama, Ehime Prefecture.

To improve overall operation of its Niihama precious metals refinery, Sumitomo Metal Mining reportedly was undertaking a modernization project in 1993. The existing refining furnaces would be replaced by the Bottom Blown Oxygen Converter (BBOC), marketed by Mount Isa Technology Marketing Ltd. of Australia. BBOC would reduce processing time and fuel consumption as well as raise the recovery rate and reduce in-process silver.

In 1993, Japan relied on imports to meet 49% of its gold metal demand and 18% of its silver metal demand. Because of further weakening of domestic demand, imports of gold metal dropped from 195,051 kg in 1992 to 176,307 kg in 1993. Of the total gold imported in 1993, 35% was from Australia, 21% from Switzerland, 18% from the United Kingdom, 9% from the Republic of South Africa, 5% from New Zealand, 4% from Russia, 3% from the United States, and 5% from other countries. Imports of silver metal declined by 6% to 584 tons because of reduced domestic demand in all major consuming sectors except in electrical contacts and electroplating. The principal silver metal suppliers in 1993 were Mexico, providing 253 tons; the United States, 190 tons; Australia, 50 tons; and Chile, 47 tons. *(See table 9.)*

Indium.—Japan remained the world's leading producer and consumer of indium metal in 1993. Indium metal extracted from zinc residue and from indium content of scrap declined slightly from that of 1992, despite the continued strong demand by the manufacturers of indium-tin oxide (ITO) for making liquid crystal displays (LCD's). The raw materials, such as indium content of zinc ore and semiconductors scrap, were obtained from both domestic and overseas sources.

Nippon Mining and Metals Co. Ltd., the world's largest producer of indium metal, produced indium metal at the

indium plants of its Saganoseki complex in Oita Prefecture and its Hitachi refinery in Ibaraki Prefecture using zinc residue with a total capacity of 33 mt/a. The zinc residue was generated mainly from its Mikkaichi zinc refinery in Toyama Prefecture. The indium content of zinc concentrate feeding the Mikkaichi refinery originated principally from Nippon Mining's Toyoha lead-silver-zinc mine near Sapporo in Hokkaido.

Sumitomo Metal Mining recovered indium as a byproduct of its Harima zinc refinery near Kobe in Hyogo Prefecture using both imported ore and scrap with a capacity of about 12 mt/a. Mitsui Mining & Smelting Co. Ltd. produced indium metal at its Takehara plant in Hiroshima Prefecture using zinc residue supplied by its affiliate Hachinohe zinc refinery in Aomori Prefecture with a capacity of 10 mt/a. Dowa Mining Co. Ltd. produced indium metal as a byproduct of its Kosaka copper-lead refinery in Akita Prefecture using local black ore containing indium with an estimate capacity of about 2 to 3 mt/a. To meet domestic demand for indium, Japan imported 46,781 kg of indium metal, including powder and scrap. The major suppliers were France, 25,581 kg; China, 8,522 kg; Canada, 4,302 kg; the United States, 3,661 kg; and Belgium, 3,025 kg.

According to Japan's Rare Metals News, demand for indium in 1993 was estimated at 71 tons, slightly higher than that of 1992. Of the total demand, 28 tons was by producers of ITO for making LCD's, 10 tons by producers of indium-boron oxide for making florescent materials, 6 tons by producers of high-purity compounds for making semiconductors, 5.5 tons by producers of bonding alloys for targets, 5 tons by producers of low melting point alloys, 2.5 tons by producers of dental alloys, and 14 tons for batteries, bearings, videcom tubes, and other uses.

Iron and Steel.—Mine production of iron sand and roasted pyrite was small and insignificant. Japan's iron and steel industry relied on imports to meet virtually all of its iron ore requirements. Imports of iron ore, including iron sand, pellet, and sinter, increased slightly to 114.5 Mmt in 1993 from 113.7 Mmt in 1992. Australia, Brazil, and India remained the three dominant sources of iron ore, providing 46.7%, 24.3%, and 14.5%, respectively, in 1993. Imports of pig iron, including direct-reduced iron, also increased slightly to 1.6 Mmt in 1993 from 1.5 Mmt in 1992. The five major suppliers of pig iron in 1993 were Russia providing 444,589 tons; Brazil, 303,653 tons; Ukraine, 285,714 tons; India, 117,305 tons, and Venezuela, 113,045 tons. According to the Ministry of Finance, Japan's import c.i.f. price per ton of iron ore dropped from $27.97 in 1992 to $26.56 in 1993, and its import c.i.f. price per ton of pig iron rose from $161.86 in 1992 to $168.50 in 1993.

Consumption of iron ore, including iron sand, pellet, and sinter by blast furnaces, increased slightly to 121.34 Mmt in 1993 from 120.54 Mmt in 1992. Of the total pig iron produced in 1993, 99% was for steelmaking and 1% was for foundry uses. By the end of 1993, the total number of furnaces, including blast furnaces, electric furnaces, and other furnaces for pig iron production, remained at 47, but pig iron production capacity dropped to 97.6 Mmt/a from 99 Mmt/a in 1992.

After the breakup of the former U.S.S.R., Japan became the world's largest pig iron and crude steel producer, accounting for 14.7% and 13.7%, respectively, of the world production in 1993. In 1993, Nippon Steel Corp., the largest steelmaker in the Western World, along with four other major steelmakers, continued to maintain its leading position in the world. *(See table 10 and figure 2.)*

Because of the continued economic slowdown in 1993, domestic demand for steel by the automobile, construction, industrial machinery, and all other industries fell in 1993. However, exports of steels rose sharply in 1993. As a result, crude steel output rebounded to slightly below the 100-Mmt level. Of the crude steel produced in 1993, 68.8% was processed by the basic oxygen furnaces and 31.2% by the electric furnaces. The steelmaking sector, according to MITI, reduced the number of basic oxygen furnaces by 1 to 71 and reduced the number of electric arc furnaces by 6 to 474 units by the end of 1993. As a result, the overall crude steel production capacity was cut by 2.33 Mmt/a to 137.95 Mmt/a in 1993. The industry's labor force also was being cut by 4,557 to 287,068 workers at the end of 1993.

Despite increased public works investment provided by the Government's economic stimulus package, private housing starts as well as private plant and equipment investment remained sluggish in 1993. As a result, steel demand by the construction and most manufacturing industries declined. According to Japan Iron and Steel Federation (JISF), overall domestic demand for steel declined in 1993 owing to a decline in private investment in plant and equipment by the manufacturing sector, especially the automobile, electric and industrial machinery industries. *(See table 11.)*

Exports of iron and steel products, which included pig iron, ferroalloys, ordinary steels, specialty steels, semifinished steel, steel slab, and other iron and steel products, increased sharply to 24 Mmt in 1993 from 19 Mmt in 1992. This 24% increase in overall exports of iron and steel products was attributed to a substantial increase in exports to China in 1993. In 1993, exports to China rose to 6.9 Mmt from 2.4 Mmt in 1992. Other major buyers of Japan's iron and steel products in 1993 included Taiwan, 2.9 Mmt; Thailand, 1.9 Mmt; the United States, 1.8 Mmt; the Republic of Korea, 1.7 Mmt; Hong Kong, 1.2 Mmt; and Singapore, 1.1 Mmt. Of the total exports in 1993, 18.6 Mmt was ordinary steel products; 3.6 Mmt, specialty steel products; and 1.3 Mmt, pig iron semifinished steel and other steel products. According to the Ministry of Finance, despite a lower average export price, which dropped to $660.51/mt in 1993 from $748.42/mt in 1992, export earnings from iron and steel products rose to $15.5 billion in 1992 from $14.2 billion in 1992 because of increased export volume in 1993.

Imports of iron and steel products rose 3.6% to 9.2 Mmt in 1993. Of the total imports, 5.6 Mmt was ordinary steel

products; 1.6 Mmt, pig iron; 1.4 Mmt, ferroalloys; and the remaining 600,000 tons was steel slab, semimanufactured, wire, and specialty steel products. Hot-rolled heavy plates, hot-rolled wide strip, hot-rolled wire rods, cold-rolled wide strip, and galvanized steel sheet were the major import steel products in 1993. In 1993, the Republic of Korea remained the dominant supplier providing 2.8 Mmt, followed by Brazil, 923,000 tons; Taiwan, 864,000 tons; Russia, 619,000 tons; and China,610,000 tons. According to the Ministry of Finance, average import prices of iron and steel products rose to $446.99/mt in 1993 from $433.19/mt in 1992.

Manganese.—Japan's only operating manganese mine, the Nodatamagawa Mine in Iwate Prefecture, was a small-scale mining operation with only six regular workers in 1993. Japan relied on imports for virtually all of its manganese ore requirements in 1993. Imports of manganese ore rose 25.8% to 1,210,736 tons in 1993, of which 7,133 tons was manganese dioxide and 1,203,603 tons was metallurgical-grade manganese ore. Australia, China, and Gabon were the three principal suppliers of manganese dioxide, providing 48.7%, 26%, and 14%, respectively, in 1993. The major suppliers of metallurgical-grade manganese were Australia, the Republic of South Africa, and Ghana, providing 45%, 42%, and 5%, respectively, in 1993. Japan also imported 140,032 tons of ferruginous manganese ore from the Republic of South Africa and India.

The overall consumption of metallurgical-grade manganese ore and ferruginous manganese dropped by 4.4% to 1,232,669 tons in 1993 mainly because of reduced consumption of metallurgical-grade manganese for production of sinter and steel in 1993. *(See table 12.)*

Japan was the world's leading producer of electrolytic manganese dioxide (EMD). In 1993, the total EMD production capacity controlled by three Japanese producers accounted for more than 40% of the world's total. According to local press reports, Tosoh Corp., Japan's top producers of EMD, is to cut its employees by 1,000 out of 4,800 by 1995. Out of this 1,000 workers, 200 will be reduced by spinning off its 24,000-mt/a plant in Hyuga, Miyazaki Prefecture. Tosoh also has a 12,000-mt/a plant, which is operated by a joint-venture firm called Tosoh Hellas A.I.C. with Mitsubishi Corp. in Salonika, Greece. According to Japan Chemical Week, the Salonika plant in Greece had been modernized in mid-1993 costing about $14 million and is capable of producing high-grade EMD for the manufacture of dry cell battery.

Mitsui Mining & Smelting Co., Japan's second largest producer, planned to raise the capacity of its Takehara plant in Hiroshima Prefecture to 25,000 mt/a from 23,500 mt/a and its overseas plant to 17,000 mt/a from 12,000 mt/a in County Cork, Ireland. The Ireland plant is operated by its subsidiary, Mitsui Denman (Ireland) Ltd. The modernization of the two plants will involve replacement of the old electrodes with a new and more efficient type. Mitsui Mining & Smelting also planned to spend about $29 million to construct a new EMD plant with a capacity of 12,500 mt/a in Ireland.

Japan Metal and Chemicals Co. Ltd., Japan's third producer of EMD, operated an EMD plant with a capacity of 18,000 mt/a in Takaoka, Toyama Prefecture.

According to MITI, total shipments of EMD, which included domestic demand and exports, increased from 54,290 tons in 1992 to 58,512 tons in 1993. Stocks at the end of 1992 decreased from 10,099 tons in 1992 to 9,998 tons in 1993.

Nickel.—Japan remained the world's largest consumer and the third largest producer of nickel metal, including ferronickel, nickel oxide, and refined nickel, in 1993. However, all of its raw material requirements for nickel, including nickel ore, ferronickel, and refined nickel, were met by imports. In 1993, imports of nickel ore continued the 1992 downward trend and declined by another 12.5% to 3 Mmt reflecting the lower price of ferronickel and weakening competitiveness of domestic ferronickel producers due to the appreciation of the Japanese yen.

New Caledonia, Indonesia, and the Philippines remained the three suppliers, providing 1,576,255 tons, 885,223 tons, and 580,250 tons, respectively, in 1993. According to Japan's trade statistics, the average water and nickel contents of the nickel ore from New Caledonia were 25% and 2.5%, respectively; from Indonesia, 33% and 2.5%, respectively; and from the Philippines, 30% and 2.4%, respectively.

Consumption of nickel ore by the ferroalloy industry for the production of ferronickel, dropped 9.6% to 2.2 Mmt in 1993. However, imports of ferronickel in 1993 rose sharply by 36% to 44,342 tons because of the lower price of nickel and appreciation of the Japanese yen. The major suppliers of ferronickel in 1993 were New Caledonia, 25,252 tons with an average nickel content of 25%; the Dominican Republic, 7,864 tons with an average nickel content of 38%, Indonesia, 5,217 tons with an average nickel content of 19%; and Colombia, 4,928 tons with an average nickel content of 40%.

Consumption of ferronickel increased by 23.8% to 306,325 tons from 247,362 tons in 1992 because of increased production of nickel-based stainless steel for export in 1993.

Imports of nickel matte for the production of refined nickel and nickel oxide declined from 65,809 tons in 1992 to 63,622 tons in 1993, of which 43,013 tons was from Indonesia and 20,609 tons was from Australia. Western Mining Corp. Ltd. of Australia and P.T. Inco of Indonesia remained the two suppliers of nickel matte. Imports of nickel oxide and oxide sinter increased from 1,894 tons in 1992 to 2,396 tons in 1993. Australia remained the sole supplier of nickel oxide and oxide sinter in 1993.

Production of refined nickel by Sumitomo Metal Mining at its Niihama plant in Ehime Prefecture increase in 1992. Imports of refined nickel, including powder and flake, increased by 19% to 39,806 tons in 1993 from 33,466 tons in 1992 owing to increased domestic demand for refined nickel by the manufacturers of specialty steel and magnetic

material. The major suppliers of refined nickel, including powder and flake, in 1993 were Norway, 8,350 tons; Canada, 7,337 tons; Zimbabwe, 7,081 tons; the United Kingdom, 5,780 tons; Russia, 4,705 tons; Brazil, 1,948 tons; and Australia, 1,899 tons. Exports of refined nickel, including powders and flakes, totaled 69 tons, of which 64 tons went to Indonesia and 5 tons of nickel powder and flakes went to the Republic of Korea, Thailand, and the United States.

According to MITI, consumption of refined nickel rose by 6.6% in 1993 owing mainly to increased demand by the producers of specialty steel and magnetic materials, when exports of these products rose in 1993. *(See table 13.)*

Rare Earths.—Japan remained a major world consumer of rare earths. All of Japan's rare-earth requirements were met by imports. Japan imported rare-earth chlorides and compounds for further processing into rare-earth products. Japan also imported a wide variety of rare-earth products to meet its domestic demand.

Domestic production of rare-earth products continued the 1992 downward trend owing to a further slowdown in the Japanese economy in 1993. According to Japan's Rare Metal News, there were 12 companies in 1993 producing a wide variety of rare-earth products using imported raw materials from Brazil, China, India, Malaysia, and the United States. *(See table 14.)* Nippon Rare Earth Co. Ltd., a joint venture of Sumitomo Metal Mining and Rhone-Poulenc of France, is to be dissolved in March 1994. Dowa Rare Earth Co. Ltd. had been integrated into the Chemical Div. of Dowa Mining.

Applications of rare earths in the 1950's and the 1960's were limited to the use of rare-earth fluorides for arc carbon, misch metal for pyrophoric alloys, and cerium and lanthanum oxides for use as a glass polishing agent, as an additive in optical lenses, and as phosphors in television (TV) manufacturing. Application of rare earths in magnetic materials began in the 1970's and greatly expanded in the 1980's. According to MMAJ, cerium oxide was used mainly as a polishing agent for TV tube glass, plate glass, and optical glass; decoloring of TV tube glass; and as a catalyst for automobile exhaust control, when used with lanthanum. Lanthanum oxide was used as an additive in optical lenses and ceramic condensers. Samarium and neodymium oxides were used for the manufacture of magnetic materials for computer printers and monitors. Europium oxide and yttrium oxide were used as a red phosphor in the manufacture of color TV phosphors and tricolor fluorescent lamps. Misch metal was used for the manufacture of auto parts and pyrophoric alloys for cigarette lighters. *(See table 15.)*

Titanium.—Japan remained the second largest producer of titanium sponge and one of the major producers of titanium dioxide pigment in the world. However, all of Japan's raw material requirements were met by imports. In 1993, Japan imported 50,000 tons of rutile, principally from Australia. Imports of ilmenite totaled 445,000 tons, mainly from Australia, Canada, India, Malaysia, and Vietnam. Japan also imported 80,000 tons of titanium slag, principally from the Republic of South Africa, in 1993. The average import c.i.f. price of rutile was $394.78 per ton in 1993 compared with $469.61 per ton in 1992. The average import c.i.f. price of ilmenite was $88.13 per ton in 1993 compared with $111.29 per ton in 1992. The average import c.i.f. price of titanium slag was $304.85 per ton in 1993 compared with $307.81 per ton in 1992.

All of the rutile was consumed by the producers of titanium sponge metal. Ilmenite and titanium slag were consumed mainly by the titanium dioxide producers for production of pigment and synthetic rutile. A small amount of ilmenite was consumed as a blast furnace additive in the steel industry. According to the Japan Titanium Society, despite a rebound in domestic demand in 1993, production of titanium sponge continued the 1992 downward trend because of a sharp drop in exports affected by a worldwide reduction in demand from the military aircraft industry.

Production of titanium sponge was by Sumitomo Sitix Corp. (formerly Osaka Titanium Co. Ltd.) at Amagasaki, near Osaka, in Hyogo Prefecture with a capacity of 15,000 mt/a; Toho Titanium Co. Ltd. at Chigasaki, about 20 km south of Yokohama, in Kanagawa Prefecture with a capacity of 10,900 mt/a; and Showa Titanium Co. Ltd., in Toyama in Toyama Prefecture with a capacity of 3,200 mt/a. In 1993, Toho Titanium completed the $37 million renovation of its sponge production facilities to increase efficiency and reduce production costs.

According to the Japan Titanium Society, domestic demand for titanium sponge rose by 11.5% to 12,132 tons, while the overseas shipments of titanium sponge dropped 24% to 2,962 tons in 1993. According to the Ministry of Finance, titanium sponge exports dropped from 4,044 tons in 1992 to 2,897 tons in 1993, of which 1,668 tons went to the United Kingdom, 840 tons went to the United States, 165 tons went to Germany, 82 tons went to France, 71 tons went to the Republic of Korea, 55 tons went to India, and 11 tons went to other countries. Japan also exported 1,734 tons of titanium waste, scrap, and powder, principally to the United States with 1,249 tons; the United Kingdom, 269 tons; and Germany, 140 tons, in 1993.

Production of titanium dioxide pigment continued the 1992 downward trend to a 5-year low in 1993 because of reduced demand by all consumers of titanium dioxide pigment. The 1993 output was equivalent to 74.5% of the industry's capacity. According to Japan's Rare Metal News, as of June 1993, Japan's titanium dioxide industry consisted of seven companies with a capacity of 333,000 mt/a in 1993.

Ishihara Sangyo Co. Ltd. operated two plants in Yokkaichi, Mie Prefecture, with a capacity of 154,800 mt/a. Teika Co. Ltd. operated a plant in Saidaiji, Okayama Prefecture, with a capacity of 48,600 mt/a. Sakai Chemical Industries Co. Ltd. operated a plant in Onahama, Fukushima Prefecture, with a capacity of 43,200 mt/a. Tohkem Products Corp.

operated two plants in Akita, Akita Prefecture, with a capacity of 30,000 mt/a. Furukawa Co. Ltd. operated a plant in Osaka, Osaka Prefecture, with a capacity of 23,400 mt/a. Titan Kogyo Co. Ltd. operated a plant in Ube, Yamaguchi Prefecture, with a capacity of 16,800 mt/a. Fuji Titanium Industry Co. Ltd. operated a plant in Kobe, Hyogo Prefecture, with a capacity of 16,200 mt/a.

Ishihara Sangyo Co. Ltd. planned to expand capacity of its Yokkaichi complex by constructing a 60,000-mt/a plant using a chloride process in 1995. The new plant was scheduled for completion in 1997. As part of its long-term capacity expansion plan for the growing market in the Asia and Pacific region, Ishihara Sangyo also planned to expand the capacity of its overseas plant in Singapore from 42,000 mt/a to 50,000 mt/a.[12]

According to the Japan Titanium Dioxide Industry Association, total shipments of titanium dioxide decreased from 265,635 tons in 1992 to 243,700 tons in 1993, of which 59,067 tons was exports. Japan also imported 66,000 tons of titanium dioxide pigment for domestic consumption in 1993. Producer stocks at the end of 1993 rose to 21,464 tons from 19,771 tons in 1992.

The domestic shipments for titanium dioxide pigment continued the 1992 downward trend and dropped by 8.8% to 184,633 tons in 1993 because of a further slowdown in activity in the automobile, home appliance, and construction industries. By end use, the paint industry, which accounted for 45.7% of the total domestic shipments, declined by 13.7% to 84,362 tons; the ink and pigments industry, which accounted for 19.7% of total demand, declined by 3.9% to 36,321 tons; the plastics industry, which accounted for 10.6% of total demand, declined by 3.4% to 19,588 tons; and the paper manufacturing industry, which accounted for 9.3% of total demand, declined by 2.8% to 17,137 tons in 1993. Other industry uses, such as for rubber, chemical fibers and others, all suffered a decline.

Tungsten.—Mine production of tungsten ore and concentrate dropped sharply in 1993 because of mine closures. Japan's remaining two small-scale scheelite mines, the Kiwada Mine and the Kuga Mine in Yamaguchi Prefecture, were permanently closed at the end of March 1993 owing to lower tungsten prices and the appreciation of the Japanese yen. Imports of tungsten ore and concentrate also declined from 717 tons in 1992 to 459 tons in 1993, of which 180 tons was from Portugal, 157 tons from China, 47 tons from Peru, and 48 tons from Thailand. Japan's import reliance of tungsten ore and concentrate was about 80% in 1993.

According to JMIA, domestic demand for tungsten ore and concentrate also declined from 1,484 tons in 1992 to 1,387 tons in 1993, of which 1,148 tons was for production of tungsten metal; 155 tons for production of calcium tungstate clinker; 67 tons for production of ferrotungsten, and 17 tons for other uses. Because of decreased domestic mine output and lower imports, overall stocks at the end of the period decreased from 1,474 tons in 1992 to 815 tons in 1993.

Industrial Minerals

Cement.—Japan remained the world's third largest cement producer after China and Russia in 1993. Cement production declined in 1993, despite the Government efforts to boost public works projects. Overall construction activity remained slow in 1993. According to cement industry sources, many local governments were cautious and slow in signing public works contracts because of scandals that had resulted in the arrests of public officials and executives of construction companies.

According to MITI, Japan's total cement clinker capacity increased to 91.3 Mmt/a in 1993 from 90.4 Mmt/a in 1992. Because of lower cement prices, sluggish domestic demand, and intensified competition in the export market, several major cement companies took action to trim their work force. As a result, the industry's work force at the end of 1993 dropped to 6,482 from 6,677 in 1992.

To cope with the problems of reduced domestic demand, the appreciation of the Japanese yen, and lower cement prices in the wake of competition with neighboring countries such as the Republic of Korea, Japan's cement companies were in the process of consolidating their operations. In November, Onoda Cement Co. Ltd., Japan's second largest cement producer, announced that it will merge with Chichibu Cement Co. Ltd., Japan's sixth largest cementmaker, and will establish Chichibu Onoda Co. Ltd. on October 1, 1994. The new company, to be capitalized at about $312 million, will have sales of $2.4 billion and a 24% share of domestic market. By this merger, according to company officials, it not only will contribute to the stability of Japan's cement industry, but also will reduce overall costs by combining the sales networks of both companies.[13]

In 1993, the industry consumed about 98.2 Mmt of limestone, 19.3 Mmt of clay, 5.4 Mmt of silica stone, 4.5 Mmt of ore slag, and 3.4 Mmt of gypsum. Total energy consumption by the industry included about 9 Mmt of coal, 1.1 Mmt of petroleum coke, 376,900 kL of heavy fuel oil, 4,800 tons of coke, and 9,600 megawatts hours of electricity in 1993.

According to the Cement Association of Japan, domestic consumption of cement continued the 1992 downward trend and dropped by 4.4% to 78.1 Mmt in 1993, while exports of cement, including clinker, rose by 14.3% to 13.1 Mmt 1993. Of the total domestic demand for cement in 1993, 69.4% was for ready-mixed concrete; 15.3% for cement products; 5% for civil engineering works; 1.9% for public and private buildings; 1.5% for construction of roads, bridges, powerplants, and ports; and 6.9% for other uses.

In 1993, exports of clinker rose from 5 Mmt in 1992 to 6 Mmt and were valued at $205.7 million in 1993. Exports of portland cement increased from 6.4 Mmt to 7.1 Mmt and were valued at $267 million. Malaysia, Singapore, Taiwan, and Thailand were the major buyers of clinker. Hong Kong, the Republic of Korea, Singapore, Taiwan, and Thailand were the major buyers of portland cement in 1993. The

average export f.o.b. price per ton of portland cement decreased to $37.06 in 1993 from $39.61 in 1992. Imports of portland cement decreased from 1.1 Mmt in 1992 to 1 Mmt and were valued at $51.8 million in 1993. The principal supplier of portland cement in 1993 was the Republic of Korea. Japan imported only 1,859 tons of clinker in 1993. The average import c.i.f. price per ton of portland cement decreased to $46.61 in 1993 from $47.25 in 1992.

With limited domestic growth potential, Japanese cementmakers were moving aggressively overseas, especially in Asia, to take advantage of low labor costs and greater market potential in China and Southeast Asian countries. Several major cement producers had established joint-venture firms to produce cement in China, the Philippines, and Vietnam. In addition to Onoda Cement Co.'s joint production of cement in Dailian, China, according to the Nihon Keizai Shimbun (Japanese Economic Journal), Mitsubishi Material is expected to bring on-stream a 900,000-mt/a cement plant in Yantai, China, in 1996. Nihon Cement Co. and Onoda Cement Co. had two separate joint-venture projects with the Chinese and are to bring on-stream a 1.4-Mmt cement plant in Chinwang Tao, China, and a 1.28-Mmt/a cement plant in Nanjing, China, respectively, in 1996. Sumitomo Cement Co. and Tokuyama Corp. had two separate joint-venture projects with the Philippines and are to bring on-stream a 1.2-Mmt/a cement plant, in Davao, the Philippines, and in Cebu, the Philippines, respectively in 1996 and 1998. In 1993, Mitsubishi Materials and Nihon Cement signed an agreement with the Vietnamese Government to establish a joint-venture project for construction of a cement plant in the Province of Thanh Hoa, about 200 km south of Hanoi in Vietnam. The $325 million project involved construction of a 2.3-Mmt/a cement plant and improvement of nearby infrastructure, such as roads and port facilities.[14]

Limestone.—Japan is self-sufficient in limestone. Its annual output ranks the third largest in the world. Because of the reduced demand by the cement, iron and steel, and lime industries, production of limestone continued the 1992 downward trend and dropped to a 3-year low. According to the Limestone Association of Japan, the industry consists of about 250 limestone mining companies with most of the major quarries being controlled by cement and steel companies. In 1993, the seven leading limestone mining companies, in decreasing order, were Nittetsu Mining Co. Ltd., Todaka Mining Co. Ltd., Onoda Cement Co. Ltd., Ube Industries Ltd., Mitsubishi Materials Corp., Sumitomo Cement Co. Ltd., and Sumimetal Mining Co. Ltd.

According to MITI, shipments of lime declined from 211 Mmt in 1992 to 203.2 Mmt in 1993, of which 140.5 Mmt was consumed by the manufacturing sector, 57.3 Mmt by the construction sector, and 5.4 Mmt by other. Of the 140.5 Mmt, 98.9 Mmt was consumed by the cement industry, 21.5 Mmt by the iron and steel industry, 10.5 Mmt by the lime industry, and 9.6 Mmt by other manufacturing industries. Of the 57.3 Mmt, 30.3 Mmt was consumed for concrete-making, 20.2 Mmt was for road construction, and 6.8 Mmt was for other construction.

Mineral Fuels

Coal.—Japan's coal production continued to shrink and reached its lowest level since 1902. The 1993 output was in line with the rationalization plan recommended by MITI's Coal Mining Industry Council in 1992. Japan had stopped production of metallurgical-grade bituminous coal (coking coal) since April 1990 and stopped production of anthracite since April 1991. In 1993, the industry produced about 7.2 Mmt of steam coal, of which 53% was from the Hokkaido area and 47% from the Kyushu and Honshu areas. The industry's employment declined by 242 to 3,676 at the end of 1993, and its labor productivity, as measured by metric tons per month per miner, rose to 159.1 in 1993 from 149.6 in 1992.

Japan remained the world's largest coal importer. Coal imports increased 2.1% to 111.4 Mmt in 1993. In 1993, imports of coking coal increased slightly from 64.5 Mmt in 1992 to 65.0 Mmt in 1993. Imports of anthracite increased from 2.4 Mmt in 1992 to 2.8 Mmt in 1993. Imports of steam coal increased from 42.3 Mmt in 1992 to 43.7 Mmt in 1993. In 1993, Japan relied on imports to meet 94% of its coal requirement, compared with 92.2% in 1991. *(See table 16.)*

Overall consumption of coal increased by 1.7% to 118.8 Mmt in 1993 owing mainly to increased demand for steam coal by the cement and utility industries in 1993. The upward trend in steam coal demand by the utility industry is expected to continue. Demand for steam coal by the utility industry increased from 28.2 Mmt in 1991 to 31.6 Mmt in 1992 and to 32.8 Mmt in 1993. *(See table 17.)*

To meet its growing coal requirements with a declining domestic coal production, Japan was actively seeking additional sources of coal overseas. In 1993, Mitsui Mining & Smelting agreed to a joint venture with Savage Resources of Australia and four South Korean companies to develop the Togara North coalfield in Queensland, Australia. The minable coal resources in the Togara North area, about 40 km west of Blackwater and 300 km west of the port of Gladstone, were estimated at 800 Mmt. The joint venture planned to complete mine development by 1997 with a mine capacity of 3 Mmt/a at a total cost of about $90 million.[15]

In the United States, an agreement was signed between the United States and Japan in April to establish a joint-venture holding company, called the Los Angeles Export Terminal, Inc., to build a $120 million dry bulk terminal at the Port of Los Angeles to promote exporting coal from the United States to Japan. According to local press reports, 49% of the joint-venture project was owned by a Japanese consortium of 9 Japanese electric power companies and more than 20 trading and shipping companies.[16]

Petroleum and Natural Gas.—Japan remained the world's largest importer of natural gas and crude petroleum in 1993.

Its domestic production of natural gas and crude petroleum was negligible when compared to its huge requirements for crude petroleum, refined petroleum products, and LNG. Domestic production of crude petroleum decreased, while production of natural gas increased slightly in 1993. Consumption of crude petroleum and natural gas rose by 2.2% to 1,460.6 Mbbl and by 0.5% to 61 billion m^3, respectively, in 1993.

To meet the 1993 demand, according to MITI, imports of crude petroleum rose by 1.6% to 1,604.7 Mbbl, the highest since 1980. Imports of natural gas, in the form of LNG, broke the previous year's record and reached 58.7 billion m^3 in 1993. Imports of refined petroleum products, which included diesel, gasoline, heavy fuel oil, jet fuel, kerosene, and naphtha, continued the 1992 downward trend and dropped by 13.4% to 179 Mbbl because of increased domestic production and reduced domestic demand for these refined petroleum products in 1993.

Crude petroleum imports in 1993 came mainly from the Middle East region, accounting for 76.3%, compared with 75.4% in 1992; and Asia, including China, accounting for 19.7%, compared with 20.6% in 1992. In 1993, the main supplying countries of crude petroleum were the United Arab Emirates, 24.9%; Saudi Arabia, 21.8%; Indonesia, 8.9%; Iran, 8.5%; Qatar, 6.6%; China and Oman, 5.6% each; and Kuwait, which provided 3.3% of Japan's crude petroleum imports in 1990, supplied 4.4% in 1993, 3 years after the Persian Gulf War.

Imports of LNG totaled 39.2 Mmt in 1993, of which 45.3% was from Indonesia, 19.4% from Malaysia, 14.1% from Brunei, 12.2% from Australia, 6.2% from the United Arab Emirates, and 2.7% from the United States. Australia, which began delivery of LNG from its Northwest Shelf LAG production facility in August 1989, raised its share of Japan's LNG imports to 12.2% from 10.3% in 1991. Because of an ongoing expansion in Malaysia's LNG production capacity at the Bintulu plant in Sarawak, Malaysia, which increased its exports of LNG to Japan in 1992 and 1993, will continue to increase its share of Japan's LNG imports in the coming years.

Demand for overall refined petroleum products decreased 0.97% to 1,418.4 Mbbl, mainly because of reduced consumption of heavy fuel oil owing to reduced demand for type A and type C heavy fuel oil by the iron and steel and utility industries, respectively, in 1993. Sluggish demand for type C heavy fuel oil by the utility industry reflected weak demand for thermal power owing to the economic slump and unusually cool summer in 1993. In 1993, gasoline consumption rose by 1.6% to 301 Mbbl; naphtha increased by 0.3% to 226.8 Mbbl; jet fuel rose 8.5% to 26.9 Mbbl; kerosene increased by 2% to 176.6 Mbbl; diesel rose by 1.9% to 260.2 Mbbl; heavy fuel oil, including types A, B, and C, decreased by 6.4% to 427.5 Mbbl; and lubricants decreased by 4.5% to 14.3 Mbbl.

In 1993, consumption of domestically produced natural gas totaled 2.7 billion m^3, of which 39% was consumed by the gas industry, 26% by the utility industry, 17% by the chemical industry, 14% by the oil and gas industries, and 4% by other manufacturing and service industries. Additionally, Japan consumed 39.2 Mmt or 58.7 billion m^3 of imported natural gas in the form of LNG in 1993, of which 72.1% was consumed by the utilities industry for power generation, 26.4% by the city gas industry for household use, and 1.5% by the iron and steel industry for steelmaking.

To reduce dependence on the Middle East for sources of energy, several major Japanese trading companies began changing their business activities from importing oil and gas into participation oil and gas exploration and development and acquisition of exploration and development rights of an oilfield in Asia. The major trading companies involved in development of oil and gas resources in Asia included Itochu Corp. (C. Itoh & Co.), Marubeni Corp., Mitsubishi Corp., Mitsui & Co., Nissho Iwai Corp., and Sumitomo Corp.

To bid on development rights in China's Tarium Oil Basin, Sumitomo Corp. had teamed up with Exxon Corp. and Mobil Oil Corp. of the United States, British Gas PLC, and Pertamina of Indonesia in August. Mitsubishi Corp., Itochu Corp., Marubeni Corp., and Nippon Oil Co. also had linked up with British Petroleum to bid for oil and gas development rights in the Tarim Basin in April. Nishio Iwai Corp. had participated with Japanese Oil Exploration Co. (JAPEX), and Indonesia Petroleum Ltd. of Japan and Mobil Oil had signed a production-sharing contract with the Vietnamese Government to explore and develop oil and gas in Thanh Long block in Vietnam.

The Tokyo-based Cambodia Petroleum Exploration Co., a joint-venture of JAPEX and a Cambodian company, began test drilling about 75 km offshore southern Cambodia. The Cambodian Government granted the exploration rights to the joint-venture firm in 1991. The joint venture was the first JAPEX overseas' oil exploration venture without a major Western oil company as a partner.[17] In June, Mitsui Oil Exploration Co. purchased a 30% interest for oil exploration rights with two Norwegian partners in northwest Natuna block II, Indonesia. In July, Itochu Corp. reportedly acquired a 25% interest from Exxon for oil and gas development rights to an offshore zone in Java, Indonesia.

In far eastern Russia, negotiations between the Sakhalin State Government and Sakhalin MMMM&S consortium (MMMM&S), a consortium of Mitsui & Co. and Mitsubishi Corp. of Japan, Marathon Oil Co. and McDermott International Inc. of the United States, and the Royal Dutch Shell Group, for development of oil and gas offshore in northern Sakhalin reportedly was approaching their final stage in 1993. According to a Hokkaido press report, the terms set by the Sakhalin Government for MMMM&S to develop oil and gas in the Sakhalin 2 development region were as follows: (1) pay $100 million to the Sakhalin State Development Fund at the signing of the contract; (2) pay a $55 million bonus, of which $5 million would be paid at the signing of the contract and $50 million would be paid, when commercial production begins; (3) pay a

mineral rights fee ranging from 6% to 12% of the product's price; (4) pay a 32% income tax; (5) exempt the user's fee for sea bottom development; and (6) exempt any value added tax or tariff on the products.[18]

The Government of Japan through MITI planned to support large-scale oil and gas development projects, such as the oil and gas development project offshore Sakhalin. According to the Japan Economic Journal, MITI is to invest Government funds in the private companies participating in the project, through the Japan National Oil Corp., beginning in fiscal year 1994. The total cost of the Sakhalin oil and gas project was estimated at $9 billion. Japan reportedly is to invest in the project between $1.8 billion and $2.7 billion, of which about 90% will be in the form of loans bearing low interest rates to be made by the Export-Import Bank of Japan.

In November, three Japanese oil companies decided to call off the $9 billion joint Japanese-Saudi Arabia project agreement to build oil refineries in Japan and in Saudi Arabia due to fading prospects of profitability in the wake of the weak Japanese economy and low oil demand and high petroleum refined products inventories in Japan. The five partners planning to participate in the project were Nippon Oil Co., Nikko Kydo Co. (formerly Nippon Mining Co.), and Arabian Oil Co. of Japan, Saudi Arabia state-owned Aramco, and Caltex Petroleum Corp. of the United States.[19]

Reserves

Japan's ore reserves for limestone and other industrial minerals, such as iodine, pyrophyllite, and silica stone, are large and of world significance. With the exception of gold and zinc, its ore reserves for other minerals, especially oil and gas, and metallic minerals are negligible. *(See table 18.)*

INFRASTRUCTURE

Japan has one of the world's most modern and complete infrastructures for its mining and mineral processing industry. Despite its small land area, Japan has a highway system of 1.1 Mkm, of which 68% is paved, and a railroad network of 27,327 km, of which 93% is 1.067-m narrow gauge. Both highway and railroad networks link not only all major seaports and coastal cities on four major islands, but also connect Honshu (the main island) to the islands of Shikoku and Kyushu in the south and Hokkaido in the north via bridges and tunnels.

Japan's domestic and international telecommunication services are among the best in the world with five satellite earth stations as well as submarine cables to China, the Philippines, Russia, and the United States. For electric power transmission and distribution, Japan has a route length of 86,100 km and a circuit length of 149,000 km concentrating in the major industrial areas of Fukuoka, Hiroshima, Nagoya, Osaka, Takamatsu, Tokyo, and Toyama. Japan also has an extensive pipeline system composed of 1,800 km for natural gas, 84 km for crude petroleum, and 322 km for refined petroleum products.

Japan has 18 major ports and more than 2,000 minor ports for receiving raw materials from overseas and exporting manufactured products. The major port facilities, including the terminals and warehouses, are among the most indispensable infrastructure for the mineral industry because of their role in receiving imported raw materials, such as coal, iron ore, nonferrous ore, phosphate rock, crude petroleum, and LNG for mineral processing plants and powerplants as well as exporting value-added mineral and metal products. The major seaports of major mineral processing centers are Chiba, Fushiki-Toyama, Himeji, Hiroshima, Kawasaki, Kobe, Osaka, Nagoya, Niigata, Tokuyama-Shimomatsu, Shimizu, Shimonoseki, Tokyo, Wakayama-Shimotsu, Yokkaichi, and Yokohama in Honshu; Fukuoka, Kita Kyushu, and Oita in Kyushu; and Muroran and Tomakomai in Hokkaido.

OUTLOOK

The nonferrous metal mining and coal mining sectors are expected to continue the 1993 downward trend because of the ongoing restructuring programs proposed by the Government and mine closures. Mining activities of industrial minerals, such as limestone and silica stone and sand, are expected to remain steady when the Japanese economy and construction activity begin to recover in 1994. Mine production of copper, lead, and zinc is expected to decrease, when the value of the Japanese yen appreciates further and imported ore increases. The remaining four major nonferrous mines in the Prefectures of Akita, Gifu, Hokkaido, and Kagoshima are expected to continue operating. Coal output is expected to drop to below 7 Mmt in 1994, when one of the remaining four major coal mines in Hokkaido prepares for closure by March 1994.

The outlook for the mineral processing sector is equally depressed as that of the mining sector. Because of a slow recovery in the Japanese economy, most ferrous and nonferrous mineral processing plants are expected to operate at a lower level than that of 1993. According to Japan Iron and Steel Federation, production of crude steel is expected to be at the 97-Mmt level in 1994, despite the Government stimulus package. Because of the sluggish economy, production of most nonferrous metals, such as cadmium, copper, gold, nickel, rare-earth oxides, and zinc, as well as industrial minerals and cement, are expected to be lower or to remain at the 1993 level in an anticipated slow economic recovery in the second half of 1993.

Because of decreasing domestic mine production of nonfuel minerals and mineral fuels, imports of nonferrous minerals and metals as well as coal are expected to move higher or remain at the 1993 level. In line with its mineral policy to secure and diversify its long-term supply of raw materials for a steady economic growth, Japan is expected to continue actively to participate in joint exploration and development of minerals in both developed and developing countries. The targeted countries are Australia, Brazil, Canada, Chile, China,

Peru, Mexico, Mongolia, and the United States. The targeted minerals included coal, crude petroleum, base metals, antimony, columbium, lithium, molybdenum, natural gas, nickel, rare earths, strontium, tantalum, titanium, tungsten, and vanadium.

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[1]Where appropriate, values have been converted from Japanese yen (Y) to U.S. dollars ($) at the rate of Y126.7=US$1.00 in 1992 and Y111.2=US$1.00 in 1993.

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TABLE 1

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
METALS							
Aluminum:							
Alumina, gross weight	thousand tons	466	481	438	316	327	805
Metal:							
Primary:							
Regular grades	do.	35	34	32	19	18	36
High-purity	do.	16	16	20	20	20	25
Secondary[2]	do.	1,353	1,458	1,461	r1,482	1,326	1,500
Antimony:							
Oxide		10,327	10,994	11,908	11,227	10,485	12,000
Metal		173	216	262	175	225	300
Arsenic, white (equivalent of arsenic acid)[e]		500	500	500	500	500	600
Bismuth		502	442	461	530	497	550
Cadmium, refined		2,694	2,451	2,889	2,986	2,832	3,000
Chromium:							
Chromite, gross weight		11,674	8,075	e8,000	e8,000	e7,000	9,000
Metal		3,620	4,131	4,020	r3,720	e3,000	4,500
Cobalt metal		99	199	185	105	191	500
Columbium and tantalum: Tantalum metal[e]		90	90	85	80	80	150
Copper:							
Mine output, Cu content		14,650	12,927	12,414	12,074	10,277	10,000
Metal:							
Blister and anode:							
Primary		882,300	893,200	967,700	1,046,200	1,091,200	N
Secondary		123,200	147,400	117,700	128,700	72,900	N
Total		1,005,500	1,040,600	1,085,400	1,174,900	1,164,100	1,390,000
Refined:							
Primary		882,263	893,133	967,721	1,046,155	1,091,168	N
Secondary		107,303	114,843	108,562	114,704	97,608	N
Total		989,566	1,007,976	1,076,283	1,160,859	1,188,776	1,280,000
Gallium metal:							
Primary[e]		6	6	6	6	6	6
Secondary[e]		32	37	r41	r38	39	40
Germanium:							
Oxide		13	12	11	11	11	15
Metal		4	3	3	3	3	4
Gold:							
Mine output, Au content	kilograms	6,097	7,303	8,299	8,893	9,352	10,000
Metal:							
Primary	do.	110,330	108,152	103,017	107,957	108,769	120,000
Secondary[3]	do.	190,586	148,000	109,000	118,000	120,000	200,000
Total	do.	300,916	256,152	212,017	225,957	228,769	320,000
Indium metal	do.	49,465	48,077	r51,576	59,906	56,161	60,000
Iron and steel:							
Iron ore and iron sand concentrate:							
Gross weight	thousand tons	41	34	31	40	11	—
Fe content	do.	25	21	19	r25	6	—

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
METALS—Continued							
Iron and steel—Continued:							
Roasted pyrite concentrate (50% or more Fe):							
Gross weight	do.	211	210	224	244	92	100
Fe content	do.	132	131	140	153	57	60
Metal:							
Pig iron and blast furnace ferroalloys	thousand tons	80,197	80,229	79,985	73,144	73,738	99,000
Electric furnace ferroalloys:							
Ferrochrome		324,371	293,345	270,786	267,857	204,719	300,000
Ferromanganese		394,055	452,434	463,722	361,941	382,912	470,000
Ferronickel		275,341	234,311	295,422	237,350	257,316	300,000
Ferrosilicon		74,936	62,599	62,362	37,656	29,084	75,000
Silicomanganese		122,192	77,465	87,229	96,360	64,758	100,000
Other:							
Calcium silicon		808	514	410	426	400	1,000
Ferrocolumbium		737	984	710	919	1,086	1,200
Ferromolybdenum		2,784	3,366	3,729	3,261	3,656	3,700
Ferrotungsten		77	46	61	71	80	100
Ferrovanadium		3,127	3,706	3,847	r3,005	3,670	4,000
Unspecified		3,578	3,462	3,560	4,507	4,774	5,000
Total		1,202,006	1,132,232	1,191,838	r1,013,353	952,455	1,260,000
Steel, crude	thousand tons	107,909	110,339	109,649	98,131	99,623	140,300
Semimanufactures, hot-rolled:							
Of ordinary steels	do.	86,687	88,911	87,982	78,487	79,077	90,000
Of special steels	do.	15,875	16,311	16,808	14,842	14,767	18,000
Lead:							
Mine output, Pb content		18,595	18,727	18,329	18,839	16,470	17,000
Metal, refined:							
Primary		207,735	204,881	220,331	218,787	212,145	NA
Secondary		124,639	122,300	112,100	111,374	45,983	NA
Total		332,374	327,181	332,431	330,161	258,128	327,000
Magnesium metal:							
Primary		8,381	12,843	11,559	7,119	7,471	14,000
Secondary		20,270	23,308	17,158	12,978	13,215	24,000
Manganese:							
Ore and concentrate:							
Gross weight[e]		100	100	100	100	80	—
Mn content[e]		21	21	21	21	16	—
Oxide		55,628	51,473	58,526	54,294	56,106	67,000
Metal		4,498	4,571	4,439	3,800	3,900	4,500
Molybdenum metal		707	686	661	564	619	700
Nickel metal:							
Refined		21,938	22,274	23,658	22,038	23,108	28,000
Ni content of nickel oxide sinter		21,444	21,500	22,500	27,500	27,000	28,000
Ni content of ferronickel		62,834	56,474	68,045	57,447	51,120	65,000
Total		106,216	100,248	114,203	106,985	101,228	121,000

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
METALS—Continued							
Platinum-group metals:							
Palladium metal	kilograms	821	1,047	1,053	986	1,183	1,500
Platinum metal	do.	1,031	1,425	988	629	661	1,500
Rare-earth oxides:							
Cerium	do.	2,933,170	e3,100,00	e3,100,000	e2,900,000	e2,800,000	3,100,000
Europium	do.	7,673	e8,000	e7,000	e7,000	e7,000	8,000
Gadolinium	do.	49,887	e50,000	e50,000	e50,000	e50,000	50,000
Lanthanum	do.	308,804	e310,000	e300,000	e300,000	e300,000	310,000
Neodymium	do.	247,337	e250,000	e240,000	e225,000	e220,000	250,000
Praseodymium	do.	28,073	e30,000	e30,000	e25,000	e20,000	30,000
Samarium	do.	114,490	e115,000	e116,000	e116,000	e116,000	116,000
Terbium	do.	8,483	e8,000	e7,000	e7,000	e7,000	8,000
Yttrium	do.	353,842	e350,000	e350,000	e320,000	e320,000	350,000
Total	do.	4,051,759	e4,221,000	e4,200,000	e3,950,000	e3,840,000	4,222,000
Selenium, elemental		470	495	537	573	541	600
Silicon, high-purity		1,759	2,155	2,384	2,364	2,523	2,600
Silver:							
Mine output, Ag content	kilograms	155,792	149,920	170,676	178,330	136,886	180,000
Metal:							
Primary	do.	1,986,928	2,089,033	2,148,708	2,181,130	2,159,517	2,200,000
Secondary[3]	do.	166,564	229,319	126,308	130,711	143,605	230,000
Total	do.	2,153,492	2,318,352	2,275,016	2,311,841	2,303,122	2,430,000
Tellurium, elemental		51	50	57	57	47	60
Tin:							
Metal, smelter		808	816	716	821	804	850
Titanium:							
Metal		21,341	25,630	18,945	14,544	14,426	29,000
Oxide		283,184	285,851	279,054	252,479	245,992	344,400
Tungsten:							
Mine output, W content		296	260	279	347	66	—
Metal		3,758	4,176	4,147	3,307	3,477	4,500
Vanadium metal[e 4]		868	700	889	870	870	870
Zinc:							
Mine output, Zn content		131,794	127,273	133,004	134,510	118,599	130,000
Oxide		84,034	83,190	84,932	82,334	75,203	85,000
Metal:							
Primary		591,142	605,718	640,649	645,079	609,272	NA
Secondary		123,536	125,884	138,089	135,647	135,297	NA
Total		714,678	731,602	778,738	780,726	744,569	864,000
Zirconium:							
Oxide		7,100	6,820	6,750	6,380	6,200	7,500
INDUSTRIAL MINERALS							
Asbestos[e]		5,000	5,000	25,000	29,500	24,900	30,000
Bromine, elemental[e]		15,000	15,000	15,000	15,000	15,000	15,000
Cement, hydraulic	thousand tons	79,717	84,445	89,564	88,253	88,046	90,400

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Clays:							
Bentonite		526,131	549,414	554,145	534,445	515,307	560,000
Fire clay		942,199	935,878	845,867	751,661	736,230	1,000,000
Kaolin		165,696	165,532	129,942	123,154	110,314	130,000
Feldspar and related materials:							
Feldspar		43,137	57,877	88,471	r72,285	71,568	90,000
Aplite		562,823	522,744	500,272	416,304	403,724	530,000
Gypsum[e]	thousand tons	6,300	6,400	5,400	5,400	5,500	6,500
Iodine, elemental		7,592	7,581	7,492	6,764	6,489	9,900
Lime: Quicklime	thousand tons	8,486	8,983	9,045	8,049	7,958	10,000
Nitrogen: N content of ammonia	do.	1,539	1,531	1,553	1,602	1,447	1,700
Perlite[e]		202,000	203,000	203,000	203,000	200,451	210,000
Salt, all types	thousand tons	1,367	1,377	1,380	1,405	1,381	14,000
Silica sand		4,377,941	4,438,708	4,343,413	r3,842,984	3,884,287	4,500,000
Silica stone	thousand tons	17,230	17,925	18,477	19,319	18,854	20,000
Sodium compounds, n.e.s.:							
Soda ash		1,105,308	1,134,825	1,103,455	1,056,803	1,055,959	1,610,000
Sulfate		256,393	253,131	249,817	242,771	229,346	482,500
Stone, crushed and broken:							
Dolomite	thousand tons	5,465	5,371	5,318	4,854	4,761	5,500
Limestone	do.	190,854	198,224	206,780	203,854	200,452	200,000
Sulfur:							
S content of pyrite	do.	62	53	30	31	29	30
Byproduct:							
Of metallurgy	do.	1,320	1,336	1,382	1,350	1,390	1,500
Of petroleum	do.	1,176	1,268	1,244	1,250	1,250	1,300
Talc and related materials:							
Talc		55,665	61,550	65,633	61,045	57,229	67,000
Pyrophyllite		1,233,600	1,213,036	1,228,896	1,055,897	1,033,430	1,500,000
Vermiculite[e]		15,000	15,000	15,000	15,000	15,000	15,000
MINERAL FUELS AND RELATED MATERIALS							
Carbon black	thousand tons	779	788	793	771	709	800
Coal:							
Anthracite	do.	8	7	1	—	—	—
Bituminous[5]	do.	10,179	8,256	8,052	7,598	7,217	7,000
Total	do.	10,187	8,263	8,053	7,598	7,217	7,000
Coke including breeze:							
Metallurgical	do.	46,899	46,067	45,458	42,308	39,272	53,000
Gashouse including breeze	do.	2,896	1,414	1,243	1,096	1,024	3,500
Fuel briquets, all grades	thousand tons	159	128	115	110	110	200
Gas, natural:							
Gross[6]	million cubic meters	2,009	2,044	2,134	2,159	2,203	2,300
Marketed	do.	2,155	2,189	2,273	2,295	2,308	XX
Natural gas liquids:							
Natural gasoline[e]	thousand 42-gallon barrels	55	55	55	55	55	60
Liquefied petroleum gas from natural gas (field plants only)[e]	do.	250	250	300	300	300	300

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
MINERAL FUELS AND RELATED MATERIALS—Continued							
Peat[e]		60	60	60	60	60	60
Petroleum:							
Crude	thousand 42-gallon barrels	4,032	3,975	5,523	6,302	5,730	6,700
Refinery products:							
Gasoline:							
Aviation	do.	80	78	72	r78	77	100
Other	do.	241,723	265,137	278,883	r290,913	301,802	300,000
Asphalt and bitumen	do.	36,085	37,920	36,743	37,588	36,875	40,000
Distillate fuel oil	do.	174,705	201,150	236,833	r250,724	259,442	250,000
Jet fuel	do.	26,335	27,933	32,722	37,795	40,569	40,000
Kerosene	do.	128,488	145,415	153,908	163,560	169,573	170,000
Liquefied petroleum gas	do.	46,809	51,233	52,584	54,463	53,372	55,000
Lubricants	do.	12,561	15,759	15,618	15,580	15,951	17,000
Naphtha	do.	56,287	68,310	88,636	100,649	109,178	102,000
Paraffin[e]	do.	1,000	1,200	1,200	1,200	1,000	1,200
Petroleum coke[e]	do.	800	900	950	900	900	1,000
Refinery fuel and losses[e 7]	do.	140,000	e150,000	e150,000	e155,000	e150,000	XX
Residual fuel oil	do.	422,159	451,118	456,102	r476,875	479,799	500,000
Unfinished oils[e]	do.	53,200	57,000	57,000	58,000	58,000	XX
Total[e]	do.	1,340,232	1,473,153	1,561,251	r1,643,32	1,676,538	1,476,300

[e]Estimated. [p]Preliminary. NA Not available. XX Not applicable.

[1]Table includes data available through Sept. 16, 1994.

[2]Includes unalloyed ingot, alloyed ingot, billet, and mother alloys.

[3]Recovered from scrap, waste, and returned by end users.

[4]Represents metal content of vanadium pentoxide recovered from petroleum residues, ashes, and spent catalysts.

[5]Includes coking coal and steam coal. Includes steam coal only beginning in 1991.

[6]Includes output from gas wells and coal mines.

[7]May include some additional unfinished oils.

TABLE 2

JAPAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Coal	Hokutan Sorachi Coal Mining Co. Ltd.	Sorachi, Hokkido Prefecture	800
Do.	Mitsui Coal Mining Co. Ltd	Ashibetsu, Hokkaido Prefecture, and Miike, Kyushu	2,600
Do.	Matsushima Coal Mining Co. Ltd.	Ikeshima, Kyushu	1,000
Do.	Sumitomo Akabira Coal Co. Ltd.	Akabira, Hokkaido Prefecture	670
Do.	Taiheiyo Coal Mining Co. Ltd.	Kushiro, Hokkaido Prefecture	2,000
Copper:			
In concentrate	Hanaoka Mining Co. Ltd. (Subsidiary of Dowa Mining Co. Ltd.)	Hanaoka, Akita Prefecture	5
Do.	Shin Kamaishi Mining Co. Ltd. (subsidiary of Nittetsu Mining Co. Ltd.)	Kamaishi, Iwate Prefecture	1
Refined	Hibi Kyodo Smelting Co. Ltd.	Tamano, Okayama Prefecture	163.2
Do.	Mitsubishi Materials Crop.	Naoshima, Kagawa Prefecture	187.2
Do.	Nippon Mining Co. Ltd.	Hitachi, Ibaraki Prefecture and Saganoseki, Oita Prefecture	330
Do.	Onahama Smelting and Refining Co. Ltd.	Onahama, Fukushima Prefecture	234
Do.	Sumitoma Metal Mining Co. Ltd.	Besshi, Ehime Prefecture	210
Gold:			
In concentrate, kilograms	Mitsui Kushikino Mining Co. Ltd.	Kushikino, Kagoshima Prefecture	100
Do.	Sumitomo Metal Mining Co. Ltd.	Hishikari, Kagoshima Prefecture	8,500
Refined	Mitsibishi materials Corp.	Naoshima, Kagawa Prefecture	60,000
Do.	Nippon Mining Co. Ltd.	Hitachi, Ibaraki Prefecture	15,000
Do.	Sumitomo Metal Mining Co. Ltd.	Niihama, Ehime Prefecture	30,000
Limestone	Mitsubishi Materials Corps.	Higashitani, Fukuoka Prefecture	10,000
Do.	Nittetsu Mining Co. Ltd.	Torigatayama, Kochi Prefecture, Onoda-Tsukumi and Nittetsu-Tsukumi, Otia Prefecture	28,000
Do.	Sumitomo Cement Co. Ltd.	Shuho, Yamaguchi Prefecture	8,000
Do.	Todaka Mining Co. Ltd.	Todaka-Tsukumi Otia Prefecture	14,000
Do.	Ube Industries Ltd.	Isa, Yamaguchi Prefecture	11,000
Iodine, crude	Ise Chemical Industries Co. Ltd.	Oami-Shirasato, Ichinomya, Misaki, and Hikari, Chiba Prefecture; Kurosaki, Niigata Prefecture; and Sadowara, Miyazaki Perfecture	4.3
Do.	Nippon Natural Gas Industry Co. Ltd.	Minamihinato-Shirako. Koji-Shirako, Yokoshiba, and Narashino, Chiba Prefecture	1.3
Do.	United Resources Industry Co. Ltd.	Chosei and Otaki, Chiba Prefecture	1.8
Lead:			
In concentrate	Hanaoka Mining Co. Ltd.	Hanaoka, Akita Prefecture	5
Do.	Kamioka Mining and Smelting Co. Ltd. (subsiiary of Mitsui Mining and Smelting Co Ltd.)	Kamioka, Gifu Prefecture	4
Do.	Toyoha Mining Co. Ltd. (subsidiary of Nipon Mining Co. Ltd.)	Toyoha, Hokkaido Prefecture	8
Refined	Kamioka Mining and Smelting Co. Ltd.	Kamioka, Gifu Prefecture	33.6
Do.	Mitsubishi Cominco Smelting Co. Ltd.	Naoshima, Kagawa Prefecture	42
Do.	Mitsui Mining and Smelting Co. Ltd.	Takehara, Hiroshima Prefecture	43.8
Do.	Nippon Mining Co. Ltd.	Saganoseki, Oita Prefecture	36
Do.	Toho Zinc Co. Ltd.	Chigirishima, Hiroshima Prefecture	94.8
Do.	Sumitomo Metal Mining Co. Ltd.	Harima Hyogo Prefecture	30
Manganese:			
In electrolytic dioxide	Mitsui Mining and Smelting Co. Ltd.	Takehara, Toyama Prefecture	25
Do.	Tosoh Corp.	Hyuga, Miyazaki Prefecture	24

TABLE 2

JAPAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Manganese—Continued:			
In electrolytic dioxide	Japan Metals and Chemical Co. Ltd.	Takaoka, Yoyama Prefecture	18
Nickel:			
In ferronickel	Hyuga Smelting Co. Ltd. (subsidiary of Sumitomo Metal Mining Co. Ltd.).	Hyuga, Miyazaki Prefecture	18
Do.	Nippon Yakin Kogyo Co. Ltd.	Oheyama, Kyoto Prefecture	14.4
Do.	Pacific Metals Co. Ltd.	Hachinohe, Aomori Prefecture	42
In oxide	Tokyo Nickel Co. Ltd.	Matsuzaka, Mie Prefecture	36
Refined	Sumitomo Metal Mining Co.	Niihama, Ehime Prefecture	27.9
Steel, crude	Kawasaki Steel Corp.	Mizushima, Okayama Prefecture, and Chiba Prefecture	16,880
Do.	Kobe Steel Ltd.	Kakogawa and Kobe Hyogo Prefecture	8,300
Do.	NKK Corp.	Fukuyama, Hiroshima Prefecture and Keihin, Tokyo Prefecture	22,130
Do.	Nippon Steel Corp.	Oita, Oita Prefecture; Kawata, Fukuoka Prefecture; Kimitsu, Chiba Prefecture; and Nagoya, Aichi Prefecture	48,800
Do.	Sumitomo Metal Industries	Kashima, Ibaraki Prefecture, and Kokura, Fukuoko Prefecture	22,140
Pyrophyllite	Goto Kozan Co. Ltd.	Goto, Nagasaki Prefecture	204
Do.	Ohira Kozan Co. Ltd.	Ohira, Okayama Prefecture	132
Do.	Sankin Kogyo Co. Ltd.	Otsue, Hiroshima Prefecture	72
Do.	Shinagawa Shirenga Co. Ltd.	Mitsuishi, Okayama Prefecture	180
Do.	Shokozan Kogyosho Co. Ltd.	Yano-Shokozan, Hiroshima Prefecture	180
Do.	Showa Kogyo Co. Ltd.	Showa-Shokozan, Hiroshima Prefecture	60
Titanium, sponge metal	Sumitomo Sitix Corp.	Amagasaki, Hyogo Prefecture	15
Do.	Showa Titanium Co. Ltd.	Toyama, Toyama Prefecture	3
Do.	Toho Titanium Co. Ltd.	Chigasaki, Kanagawa Prefecture	10.6
Zinc:			
In concentrate	Hanaoka Mining Co. Ltd.	Hanaoka, Akita Prefecture	30
Do.	Kamioka Mining and Smelting Co. Ltd.	Kamioka, Gifu Prefecture	50
Do.	Toyoha Mining Co. Ltd.	Toyoha, Hokkaido Prefecture	60
Refined	Akita Smelting Co. Ltd.	Iijima, Akita Prefecture	156
Do.	Mitsubishi Materials Corp.	Akita, Akita Prefecture	105.6
Do.	Nikko Zinc. Co. Ltd.	Mikkaichi, Toyama Prefecture	120
Do.	Toho Zinc Co. Ltd.	Annaka, Gunma Prefecture	139.2
Do.	Hachinohe Smelting Co. Ltd.	Hachonohe, Aomori Prefecture	108
Do.	Sumitomo Metal Mining Co. Ltd.	Harima, Hyogo Prefecture	90
Do.	Hikoshima Smelting Co. Ltd.	Hikoshima, Yamaguchi Prefecture	84

TABLE 3
JAPAN: DEMAND FOR PRIMARY ALUMINUM, BY SECTOR

(Thousand metric tons)

Sector	1991	1992	1993
Aluminum rolling	1,916	1,817	1,713
Aluminum casting	104	96	90
Aluminum diecasting	34	36	30
Wire and cable	85	88	81
Steel deoxidization	40	35	25
Secondary smelting	128	106	100
Other	41	41	41
Total	2,348	2,219	2,080

Source: Ministry of International Trade and Industry (Tokyo). Yearbook of Minerals and Nonferrous Metals Statistics, 1993, p. 176.

TABLE 4
JAPAN: CONSUMPTION OF COBALT, BY END USE

(Metric tons)

End use	1991	1992	1993
Catalysts	416	358	386
Cemented carbides	365	294	276
Magnetic materials	632	474	545
Pipe, plate, rod, and wire	415	204	234
Specialty steels	896	654	691
Other	291	246	285
Total	3,015	2,230	2,417

Source: Ministry of International Trade and Industry (Tokyo). Yearbook Minerals and Nonferrous Metals Statistics, 1993, p. 196.

TABLE 5
JAPAN: IMPORTS OF COPPER IN 1993, BY FORM AND ORIGIN

(Metric tons)

Source	Copper concentrate (gross weight)	Copper scrap	Unwrought	
			Unrefined	Refined
Australia	281,122	2,878	—	23,792
Canada	729,390	403	—	1,014
Chile	818,668	37	1,507	118,462
Former U.S.S.R	23,296	224	480	2,501
Indonesia	501,474	—	—	—
Malaysia	110,981	3,657	—	—
Mongolia	32,109	—	—	—
Papua New Guinea	328,441	—	—	—
Peru	35,404	—	37,346	30,955
Philippines	367,963	4,199	—	35,624
Portugal	102,416	41	—	—
South Africa, Republic of	15,882	188	—	9,635
United States	349,287	30,407	—	47,399
Zambia	—	—	—	85,738
Other	44,374	44,364	477	8,508
Total	3,740,807	86,398	39,810	363,628

Source: Ministry of Finance (Tokyo). Japan Imports and Exports, Commodity by Country, Dec. 1993.

TABLE 6

JAPAN: SOURCE OF MATERIALS USED IN THE PRODUCTION OF COPPER, LEAD, AND ZINC

(Metric tons)

Commodity and/or source	1991	1992	1993
Copper, refined:			
Domestic ore	6,412	7,866	5,603
Imported ore[1]	961,309	1,038,289	1,093,480
Scrap	70,873	73,840	62,455
Other	37,689	40,864	27,238
Total	1,076,283	1,160,859	1,188,776
Lead, refined:			
Domestic ore	33,967	29,093	28,382
Imported ore	186,364	189,694	183,763
Scrap	9,124	10,560	11,071
Other	52,261	40,949	34,912
Secondary recovery	50,715	59,865	51,324
Total	332,431	330,161	309,452
Zinc, slab:			
Domestic ore	138,684	140,609	133,728
Imported ore	501,965	504,470	475,544
Scrap	28,077	32,591	29,259
Other	62,103	51,784	57,156
Secondary recovery	47,909	51,272	48,882
Total	778,738	780,726	744,569

[1]Includes blister.

Source: Ministry of International Trade Industry (Tokyo). Yearbook of Minerals and Nonferrous Metals Statistics, 1991-93, annual.

TABLE 7

JAPAN: SUPPLY AND DEMAND FOR GOLD AND SILVER

(Gold in kilograms, silver in metric tons)

Item	1992	1993
Gold:		
Supply:		
Domestic production	r107,956	108,769
Imports	r195,051	176,307
Secondary recovery	r93,704	e113,400
Total supply	r396,711	e398,476
Demand:		
Demand for industrial use:		
Dental and medical	15,872	16,444
Electrical, electronic, and communications apparatus	45,431	51,450
Gold plating	16,425	17,368
Gilding	243	185
Jewelry	103,979	96,562
Decorations and badges	429	457
Pottery and porcelain	3,323	3,354
Fountain pens	624	797
Watches	1,105	952
Subtotal	187,431	187,569

See footnotes at end of table.

TABLE 7—Continued

JAPAN: SUPPLY AND DEMAND FOR GOLD AND SILVER

(Gold in kilograms, silver in metric tons)

Item	1992	1993
Gold—Continued:		
Demand for industrial arts and crafts	3,221	3,713
Demand for investment and other:		
Private investment	r100,327	e100,000
Other	r70,408	e65,000
Total domestic demand	r361,387	e363,400
Exports	r35,324	e35,000
Total demand	r396,711	e413,400
Silver:		
Supply:		
Begining stock	r1,378	1,180
Primary metal production	2,181	2,160
Metal imports	622	584
Secondary recovery	131	144
Total supply	r4,312	4,068
Demand:		
Silver nitrate for photography	1,805	1,779
Silver nitrate for other uses	246	238
Electrical contacts	261	267
Brazing alloy	130	119
Electroplating	105	109
Rolled products	225	223
Jewelry and silverware	87	75
Other	403	524
Total domestic demand	3,263	3,334
Exports	225	72
Total demand	3,488	3,406
Ending stock	1,180	1,159

eEstimated. rRevised.

Sources: Ministry of Finance and the Japan Mining Industry Association.

TABLE 8

JAPAN: CRUDE STEEL PRODUCTION AND RANKING OF THE TOP SEVEN COMPANIES

	Output (thousand metric tons)		Company ranking in the world[1]	
	1992	1993	1992	1993
Nippon Steel Corp.	25,104.2	25,835.7	1	1
NKK Corp.	10,886.8	11,114.2	6	5
Sumitomo Metal Industries Ltd.	10,001.7	10,276.1	10	6
Kawasaki Steel Corp	10,000.3	10,118.9	9	8
Kobe Steel Ltd.	5,749.9	5,998.1	24	23
Tokyo Steel Manufacturing Co. Ltd.	3,945.8	4,119.6	46	40
Nisshin Steel Co. Ltd.	3,368.3	3,504.7	52	51
Total	69,057.0	70,967.3	XX	XX

XX Not applicable.

[1]Includes China, Russia, and countries in eastern Europe and Central Eurasia.

Source: Metal Bulletin (London). No. 7857, Feb. 21, 1994, p. 17.

TABLE 9

JAPAN: DOMESTIC ORDERS FOR ORDINARY STEEL AND SPECIALITY STEEL PRODUCTS, BY END USE

(Thousand metric tons)

End use	Ordinary		Specialty	
	1992	1993	1992	1993
Automobiles	10,887	9,829	2,705	2,561
Construction	15,044	13,836	605	630
Conversion and processing	3,059	3,068	3,493	3,342
Electric machinery	2,505	2,281	106	108
Home and office equipment	718	664	214	202
Industrial machinery	1,809	1,592	1,067	1,101
Rolling stock	36	31	17	18
Shipbuilding	2,750	2,509	120	67
Steel dealers	20,735	19,754	1,135	1,108
Tanks and containers	2,187	2,062	28	26
Other	282	288	68	69
Total	60,012	55,914	9,558	9,232

Source: Ministry of International Trade and Industry (Tokyo). Iron and Steel Statistics, monthly, Dec. 1993, pp. 72-73.

TABLE 10

JAPAN: CONSUMPTION OF MANGANESE ORE, BY END USE

(Metric tons)

End use	1991	1992	1993
Metallurgical-grade maganese:			
Iron and steel sector			
Ferroalloys	799,486	665,958	684,493
Pig iron	27,897	19,841	21,114
Sinter	18,146	34,320	11,611
Steel	194,808	215,959	154,152
Subtotal	1,040,337	936,078	871,370
Other uses	80,764	62,088	58,473
Total	1,121,101	998,166	929,843
Ferruginous manganese:			
Iron and steel sector			
Ferroalloys	136,790	122,796	118,034
Other	1	—	—
Pig iron	61,921	45,369	48,721
Sinter	49,370	30,458	27,075
Steel	103,863	92,338	108,996
Total	351,945	290,961	302,826

Sources: Ministry of International Trade and Industry (Tokyo). Yearbook of Iron and Steel Statistics, 1993, p. 92 and p. 97.

TABLE 11

JAPAN: SUPPLY AND DEMAND FOR REFINED NICKEL

(Metric tons)

Item	1991	1992	1993
Supply:			
Beginning stock	12,124	17,881	16,063
Production	23,658	22,038	23,108
Imports[1]	57,627	33,466	39,807
Total supply	93,409	73,385	78,978
Demand:			
Batteries	3,365	3,334	3,400
Catalyst	495	546	417
Exports	74	88	64
Galvanized sheet	5,878	5,682	5,249
Magnetic material	3,227	2,274	3,137
Nonferrous alloy	3,635	3,397	3,100
Other[2]	5,402	4,901	4,680
Specialty steel	45,494	38,803	42,848
Total demand	67,570	59,025	62,895
Ending stock	17,881	16,063	15,740

[1]Included refined nickel ingots, powder, and flakes.
[2]Inluded coinage, rolled sheet, and other.

Source: The Ministry of International Trade and Industry (Tokyo). Yearbook of Minerals and Nonferrous Metal Statistics, 1993, p. 192.

TABLE 12

JAPAN: RARE-EARTHS PRODUCERS, PLANT LOCATIONS, RAW MATERIALS, AND PRODUCTS, 1993

Company	Plant location	Raw materials	Rare-earth products
Dowa Rare Earth Co. Ltd.	Odate, Akita Prefecture	Mixed rare-earth oxides	Rare-earth oxide and fluorides
Fukui Shin Sozai Co. Ltd.	Sakai, Fukui Prefecture	Ion adsorption ores	Rare-earth compounds and salts
Mitsubishi Kasei Corp.	Kita-Kyushu, Fukuoka Prefecture	Crude rare-earth chlorides	High-purity rare-earth oxides, rare-earth metals, and rare-earth alloys
Mitsui Mining & Smelting Co. Ltd.	Omuta, Fukuoka Prefecture	Rare earth chlorides, bastnasite, ion absorption ores	Abrasives, lanthanum oxide
Nikki Co. Ltd.	Kawaguchi, Saitama Prefecture and Sashima, Ibaraki Prefecture	Crude rare-earth chlorides	Lanthanum oxide and other high-purity rare-earth chlorides
Nippon Rare Earth Co. Ltd.	Niihama, Ehime Perfecture	Intermediate rare-earths	Rare-earth oxides
Nippon Yttrium Co. Ltd.	Mitaka, Tokyo Prefecture	Xenotime, yttrium concentrate	Yttrium oxides, other rare-earth oxides, rare-earth clorides, metals, and alloys
Santoku Kinzoku Kogyo Co. Ltd.	Kobe, Hyogo Prefecture and Miki, Hyogo Prefecture	Crude rare-earth chloride, intermediate rare-earths	Rare-earth metals, master alloys, and rare-earth oxides and compounds
Seimi Chemical Co. Ltd.	Chigasaki, Kanagawa Prefecture	Bastnasite, rare-earth chlorides	Abrasives and cerium oxide
Shinetsu Chemical Kogyo Co. Ltd.	Takefu, Fukui Prefecture	Xenotime, yttrium concentrate	Yttrium oxides, other rare-earth oxides, and rare-earth compounds and salts
Shin Nippon Kinzoku Kagaku Co. Ltd.	Kyoto, Kyoto Prefecture Isa, Shizuoka Prefecture	Crude rare-earth chlorides, bastnasite	Abrasives, lanthanum oxide, other rare-earth oxides, compounds, and chlorides
Tohoku Kinzoku Kagaku Co. Ltd.	Iwaki, Fukushima Prefecture	Crude rare-earth chlorides	Abrasives, lanthanum oxide, and other rare-earth oxides and chlorides

Source: Arumu Publishing Co. Ltd. (Tokyo). Industrial Rare Metals, Annual Review, No. 107, 1993, p.71.

TABLE 13
JAPAN: CONSUMPTION OF RARE EARTH AND YTTRIUM OXIDE

(Metric tons)

Products	1991	1992	1993
Cerium oxide	3,500	3,500	3,550
Europium oxide	12	12	13
Lanthanum oxide	500	440	450
Misch metal	230	260	440
Neodymium oxide	770	840	992
Samarium oxide[1]	340	250	212
Other rare earths[2]	120	120	120
Yttrium oxide	300	300	320
Total	5,772	5,722	6,097

[1]Includes recycled scrap.
[2]Includes gadolinium oxide, praseodymium, rare-earth fluoride, terbium oxide.

Source: Japan Society of New Metals (Tokyo). Newer Metal Industry Quarterly, No. 356, June 15, 1994, p. 36.

TABLE 14
JAPAN: COAL IMPORTS, BY SOURCE

(Thousand metric tons)

	Anthracite		Bituminous			
			Coking		Steam	
	1992	1993	1992	1993	1992	1993
Australia	250	192	32,206	32,875	26,968	28,678
Canada	—	—	14,081	14,480	1,407	1,570
China	1,336	1,614	1,581	1,640	3,317	2,940
Colombia	—	—	147	162	119	—
Indonesia	—	—	885	1,555	4,246	4,301
Korea, North	297	428	—	—	—	—
New Zealand	—	—	417	304	28	—
South Africa, Republic of	119	28	3,340	2,753	2,453	2,388
United States	—	—	9,061	8,356	2,165	2,547
Russia	56	118	2,693	2,846	1,552	1,252
Vietnam	340	376	—	—	—	—
Other	—	—	57	—	—	—
Total	2,398	2,756	64,468	64,971	42,255	43,676

Source: Ministry of International Trade and Industry (Tokyo). Yearbook of Production, Supply and Demand of Petroleum, Coal, and Coke, 1993, pp. 140-143.

TABLE 15

JAPAN: COAL CONSUMPTION, BY SECTOR

(Thousand metric tons)

Sector	1991	1992	1993
Manufacturing:			
Cement, ceramics, other	18,364	18,712	18,754
Of which:			
Domestic	166	22	28
Imported	18,198	18,690	18,726
Coke	5,006	5,035	4,626
Of which:			
Domestic	100	—	—
Imported	4,906	5,035	4,626
Iron and steel	65,767	60,699	62,098
Of which:			
Domestic	135	3	—
Imported	65,632	60,696	62,098
Utilities:			
Electric power	28,239	31,579	32,746
Of which:			
Domestic	8,313	7,629	7,304
Imported	19,926	23,950	25,442
Gas	556	554	456
Of which:			
Domestic	3	—	—
Imported	553	554	456
Other	575	199	78
Of which:			
Domestic	481	166	50
Imported	94	33	28
Total consumption	118,507	116,778	118,758
Of which:			
Domestic	9,198	7,820	7,382
Imported	109,309	108,958	111,376

Source: Ministry of International Trade and Industry (Tokyo). Yearbook of Production, Supply, and Demand of Petroleum, Coal, and Coke, 1993, pp. 136-137, 144-145.

TABLE 16

JAPAN: RESERVES OF MAJOR MINERAL COMMODITIES IN 1993

(Thousand metric tons unless otherwise specified)

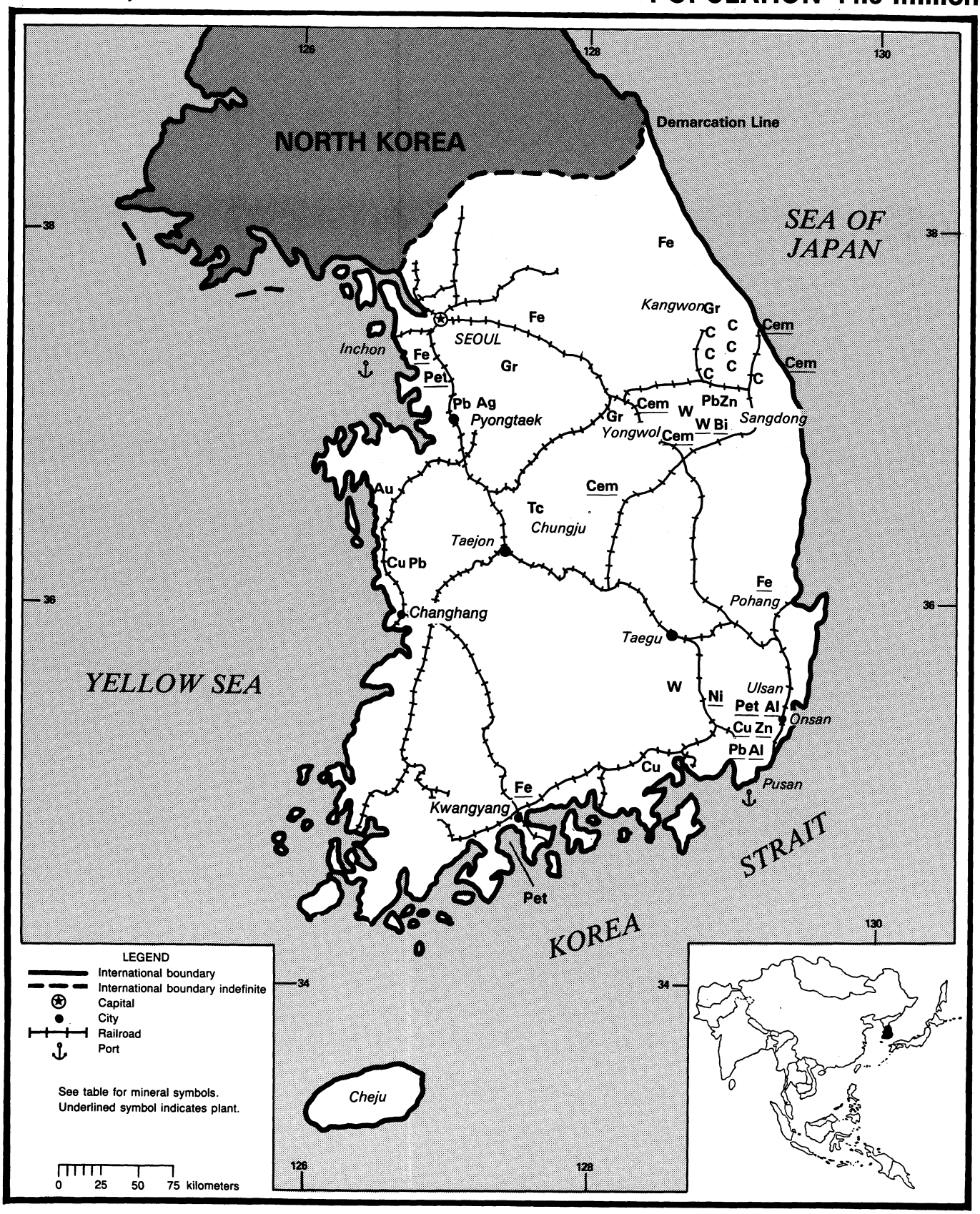
Commodity		Reserves
Coal		7,000,000
Copper ore, content		151
Dolomite[1]		1,197,662
Gold ore, content	kilograms	e550,000
Iodine		e1,800
Lead ore, content		623
Limestone[2]		57,814,046
Pyrophyllite		143,611
Silica sand[3]		357,292
Silica stone[4]		1,327,192
Zinc ore, content		3,245

eEstimated.
[1]Average ore grade is 17.9% MgO.
[2]Average ore grade is 54.2% CaO.
[3]Average ore grade is 73.1% SiO.
[4]Average ore grade is 87.9% SiO.

Source: Ministry of International Trade and Industry (Tokyo). Agency of Natural Resources and Energy.

REPUBLIC OF KOREA

AREA 98,480 km² **POPULATION 44.6 million**



THE MINERAL INDUSTRY OF

THE REPUBLIC OF KOREA

By Chin S. Kuo

The country's gross domestic product (GDP) grew at about 5.6% during 1993, as the strong Japanese yen benefited the Republic of Korea's exports at Japan's expense. The economy underwent deep structural transformation with industry deregulation and the liberalization of its financial system. The Government launched a 100-Day Economic Plan in March that was designed to stimulate the economy by slashing interest rates and assisting the country's embattled small- and medium-sized industries. However, larger business conglomerates remained the engines of the economy. The inflation rate was under control at 5%.

New capital expenditures in the automobile, cement, electronics, and oil refining industries grew at only 3% in 1993. Industrial output, in terms of volume and value, was modestly above that of the previous year. Domestic consumption slowed down and accounted for 60% of GDP. The Republic of Korea had the world's second largest shipbuilding industry. The export markets of the country's industries were shifted to China and Latin America with items such as automobiles, electronic goods, petrochemical products, and steel.

The Republic of Korea and China signed a $2 million, 3-year contract for a feasibility study to jointly explore minerals of copper and nickel in a 25.5-km^2 area of the Xinjiang Uygur Autonomous Region.

GOVERNMENT POLICIES AND PROGRAMS

During the year, the Government cut lending interest rates to 9%, underlining a policy shift to focus on growth and corporate vitality, and deemphasize stability, but the move prompted anxiety about higher inflation and real estate prices. Deregulation plans to liberalize the domestic economy also were drafted and implemented.

The Government reduced import tariffs on a number of ferroalloys and nonferrous metals. The tariff on ferrochrome was reduced from 5% to 2.5% (up to the first 50,000 tons), on ferronickel to the same level (up to 18,000 tons), and on ferrosilicon from 7% to 3.5% (up to 60,000 tons). The import duty on unwrought copper fell from 4% to 2% while that on aluminum ingots dropped from 5% to 2.5%, both for all imports.

Measures aiming at luring foreign investment were announced in November. According to the plan, foreign companies and joint ventures with foreign participation will be allowed beginning in April 1994 to buy as much as 660 m^2 of land for business purposes. The processing of applications for foreign investment will be sped up to 10 days.

The Government planned to merge the Ministry of Energy and Resources into the Ministry of Trade and Industry. Under the proposal, the latter was to take over several of the former's offices and bureaus, including the Office of Mine Registration.

PRODUCTION

Production of anthracite coal decreased 21% to 8.8 Mmt, compared with that of 1992. The country is a significant producer of nonferrous metals. Mine output of zinc ore was down 37%, whereas production of zinc ingot increased slightly by 8%. Output of copper and lead ingots rose 5% and 33%, respectively. The iron and steel industry fared better: production of pig iron and steel was modestly above the level of 1992 at 14% and 18%; however, ferroalloy output was down 7%. Cement production increased only 6% in response to the sluggish construction industry.

TRADE

The country's trade deficit narrowed to $1.36 billion in 1993 from $3.79 billion the year before. Exports totaled $82.44 billion, a 7.6% rise, while imports rose 2.4% to $83.8 billion. Exports of automobiles, electric and electronic goods, machinery, and steel products were brisk. However, shipments of labor-intensive light industrial products dropped sharply, hard hit by sluggishness in the footwear and textile industries.

Steel exports were 11.8 Mmt, nearly a 31% increase, owing to continued liftings from China, while imports decreased by more than 6% to 4.4 Mmt in 1993. In the long run, exports were to be 9.47 to 9.89 Mmt/a through 2001, whereas imports were to be kept to 3.72 to 5.34 Mmt/a. Domestic consumption increased by 8% to 25.4 Mmt. Per capita steel consumption was expected to rise by only 0.8% annually between now and the year 2001.

STRUCTURE OF THE MINERAL INDUSTRY

The Government, through its Ministries of Trade and Industry and Energy and Resources, owns and controls most of the country's large, mineral-related enterprises. Some state-owned companies have gradually gone public, and part of the Government interest has been transferred to private investors' hands. Currently, Pohang Iron & Steel Co. Ltd. (Posco) is only 35% owned by

the Government.

Because of mine shutdowns, the number of persons employed in the mining sector decreased considerably. Coal miners were still the largest group, accounting for 75% of mine employees, followed by persons in other areas of mining at 19% and metal ore miners at 6%. The mining sector is dominated by male miners, who accounted for 93% of the miner population in 1993.

COMMODITY REVIEW

Metals

Aluminum.—Aluminum of Korea Ltd.'s (Koralu) new 100,000-mt/a aluminum rolling mill at Ulsan was behind schedule in its construction and was dedicated in October. It produced its first coil in April. In the initial feed mix, Koralu planned to consume 71,000 tons of imported primary ingot and 11,000 tons of master alloy and scrap. About 26,000 tons of sheet ingot was to be added at the scalping stage. At full capacity, Koralu would be able to produce 112,000 mt/a, several years after startup. The $350 million complex, using key rolling technology fron Nippon Light Metal of Japan, has two 55-ton and two 30-ton melting furnaces, two lines of casters, a 4-high reversing single stand hot-rolling mill, and a 4-high nonreversing cold-rolling mill. About 40% of the plant's output would be foil and finstock, 20% canstock, and the rest for flat products. Plans for expanding the Ulsan plant called for the possible addition of a four-stand tandem finisher and other facilities that would lift its hot-rolling capacity to 400,000 mt/a.

Seoul-based Sam Yang Metal commissioned a 100,000-mt/a-capacity hot- and cold-rolling complex for aluminum at Yongju, 160 km southeast of Seoul. Two other companies, Choil Aluminum and Hyosung Metals, also operate aluminum rolling plants with a combined capacity of less than 60,000 mt/a. Total flat product demand in the country was about 200,000 tons and would be 220,000 tons in 1994.

The country's Ministry of Finance reached an agreement with Russia under which 29,000 to 37,000 tons of aluminum ingots was to be exported to Korea in place of interest payments on loans extended to the former U.S.S.R. The materials were shipped by Raznoimport to the Government's Office of Supply between March and June.

Copper.—Lucky Goldstar International's 40%-owned Cia Minera Los Pelambres copper mine in Chile was struck by 320 of the 800 workers early in the year because union members rejected an agreement worked out between union leaders and management. The mine also is owned 40% by Midland Bank of the United Kingdom and 20% by Luksic Group of Chile.

Poongsan Corp.'s U.S. subsidiary, PMX Industries in Cedar Rapids, Iowa, won orders for 4,901 tons of coin blanks worth $5.52 million from the U.S. Mint in June. In April, it also received orders for 6,754 tons of cupronickel and clad materials.

Poongsan Corp. and Outokumpu Copper of Finland discussed the possibility of forming a joint venture for the production and sale of rolled copper and brass sheet and strip in North America. The proposed venture was to own and operate Outokumpu's brass mills and substantially all of Poongsan's copper and brass operations in the United States and could be in place by mid-1994.

Iron and Steel.—Posco, the only integrated steelmaker, planned to spend $472 million until 1996 on all-weather wharf facilities, inland transportation centers, and other developments. Posco and Japanese subsidiaries of several Korean trading companies constructed and opened a 12,400-m^2 warehouse in Temboku, Japan, in late October to smooth the delivery of more than 60% of Posco's steel imports into Japan. Currently, this new stock distribution center handled 100,000 mt/m of steel products, such as hot-rolled coil, sheets, and higher quality coil. One-half of the cost was covered by Posco International Osaka (30%) and local trading subsidiaries of Ssangyong Corp. (10%) and Hyosung Corp. (10%). The balance was allocated by Fijiwara, a large Osaka-based transport company. Posco also planned to invest in the latest COREX iron smelting process from Austria for a 600,000-mt/a plant. Western Australian iron ore was to be tested for use in the advanced new steel production facility during the next 2 years. Western Australia currently supplies about 50% of the country's total iron ore imports.

In 1993, Posco's sales recovered as domestic automobile, electronics, and shipbuilding companies pushed up steel demand, and the Won's depreciation helped export competitiveness of steel products. The Korean shipbuilding yards received foreign orders for 15 vessels of 1.17 million gross tons in January and total orders of more than 5 million gross tons during the first half of the year. However, the downturn in Japanese steel consumption and competition from Taiwan's China Steel Corp. affected Posco with exports to Japan dropping in plates, wire rods, and hot coils.

In April, Posco halted shipments of hot coil at 75,000 mt/m to USS-Posco Industries (UPI), its 50%-owned, 1.35-Mmt/a cold-rolling and coating affiliate in Pittsburg, California. This followed the imposition of provisional antidumping and countervailing duties totaling 35% on Posco hot coil entering the United States. Beginning in May and through September, UPI received three-fourths of its hot band supply from its U.S. parent, U.S. Steel's Gary, Indiana, and Fairfield, Alabama, plants. Subsequently, the U.S. Commerce Department lowered the duties to 13%. Later in July, the International Trade Commission failed to find injury in the cases of several foreign producers of hot- and cold-rolled coils. UPI is a major producer of tinplate for the West Coast canning industry, and 40% of its ouput is tin plated. In another move, Posco sold its 45% interest in Feralloy Reliance Steel Co., the largest carbon steel processor and distributor on the West Coast, to Feralloy Corp. of Chicago, because it was unable to get a proper return for the investment.

Posco was to supply all the hot coil

and other steel products required to a joint-venture company in China, Guangzhou Jindo Container Manufacturing Co., for fabricating 40,000 shipping containers annually. Posco holds a 12.5% stake in the company, and other shareholders are Jindo Corp. of the Republic of Korea, the world's second largest container fabricator; Mitsui OSK Lines of Japan; Yau Wing Group of Hong Kong; and the Guangdong Provincial government.

Posco contemplated to build a 100-ton electric furnace at Kwangyang, which would be linked to a thin-slab caster to produce 1 Mmt/a of hot coils. Current installed capacity in hot coils was 15 Mmt/a from three hot-strip mills at Kwangyang and two at Pohang. Posco also planned to spend $600 million to expand stainless hot- and cold-roll production at Pohang that would add another 400,000 mt/a of stainless hot coil in capacity by mid-1996. At present, the Pohang works produces 380,000 mt/a of stainless hot band that is sold mostly to domestic cold-roll stainless producers such as Inchon Steel and Sammi Steel. Demand for stainless hot roll in the country was 580,000 tons and would be 730,000 tons by 1997.

Posco and Pusan Pipe began work on a new project in conjunction with Vietnam Steel Corp. to build a 30,000-mt/a pipe mill in Haiphong, Vietnam. Commercial production for 5.08-cm-diameter water pipes was to begin in July 1994 with Posco supplying hot-rolled strip. Posco's own 50-50 joint venture with Vietnam Steel to build a $56 million reinforcing steel plant, also in Haiphong, was to begin in April 1994. The 200,000-mt/a electric furnace plant was due for completion in September 1995. Meanwhile, Korea Steel Pipe discussed the possibility of forming another joint venture with Vietnamese interests to construct a $30 million pipe mill with a capacity of between 70,000 and 80,000 mt/a near Ho Chi Minh City. The hot-rolled strip also would be supplied by Posco.

Inchon Iron & Steel Co. began in June a $124 million modernization program, which was to boost its production capacity to 3.5 Mmt/a of crude steel and 1.66 Mmt/a of bars by the end of 1994. The company planned to construct a 70-ton electric furnace to add 500,000 mt/a of steel capacity at Inchon and revamp one of its three existing bar mill to raise bar capacity by 260,000 mt/a. The company also was to install a new mill to produce 600,000 to 700,000 mt/a of reinforcing bars of 9.5 to 19 mm. The mill would be supplied by Schloemann-Siemag (SMS) of Germany and was scheduled to start up in 1995.

Hanbo Steel Co., a minimill based in Seoul, negotiated with SMS of Germany for the installation of a 1-Mmt/a, $400 million thin-slab caster to be built at Asan on the west coast, 100 km south of Seoul. The new hot-strip mill would produce coil 1.6 to 25 mm thick and 900 to 1,560 mm wide with commissioning in June 1995. The country's total hot-rolled coil capacity would rise to 17.7 Mmt/a. A 1-Mmt/a bar mill, also at Asan, that began construction in 1992, was to be operational early in 1994. The company currently operates a 1-Mmt/a bar mill in Pusan and was aggressive in exporting bars to China. Together with four other major bar producers, it delayed export shipments to meet strong domestic demand during the summer construction season. Exports were raised to the intended levels in the second half of 1993.

Union Steel Manufacturing Co. redirected its exports of welded pipes from Japan to China. Pipe exports to Japan fell by 20% to 12,000 tons. The company boosted its shipments of pipes to China from 2,000 tons to 10,000 tons, of which 6,000 to 8,000 tons was gas and water pipes. Pusan Steel Pipe received orders from China for 14,000 tons of pipes; Korea Steel Pipe, 4,000 tons; Hyundai Pipe, 8,600 tons; and Dong Yang Steel Pipe, 4,000 to 5,000 tons. Hyundai Pipe also shipped 1,200 tons to Pakistan and 600 tons to Thailand.

The country's minimills diversified their sources of scrap steel feed and the raw materials mix from the United States to the Commonwealth of Independent States (CIS), Europe, and Japan. Inchon Steel imported 70% of its scrap from the United States while Dongkuk Steel Mill reduced U.S. receipts of scrap to 1 Mmt from a total requirement of 1.5 Mmt. Kangwon Industries contracted to import 30,000 tons of scrap from Poland and Dongkuk Steel and Korea Iron & Steel took 12,000 tons of Japanese scrap. Inchon Steel averaged 10,000 mt/ month of scrap shipment from Mitsubishi Corp. and Marubeni Co., both of Japan. In addition, Inchon Steel imported 30,000 tons of pig iron from Brazil and the CIS to alter its furnace feed mixes.

Nickel.—Korea Nickel Corp.'s Onsan refinery produced about 15,000 mt/a Ni in utility nickel from oxide sinter feed containing 75% to 78% Ni that was imported from Australia and Canada. The company is a joint venture of Inco, Ltd. of Canada and some Korean interests.

Zinc.—Korea Zinc Co. Ltd. has a total production capacity of 250,000 mt/a zinc metal from two smelters. The smelters bought in 500,000 mt/a of zinc concentrates, making the company the second largest custom smelter in the world after Union Miniere of Belgium.

Korea Zinc and Samsung Corp. signed an agreement with Curragh Resources of Canada for the former to inject $39.5 million new equity into Curragh, a Toronto-based lead-zinc miner. This, in addition to a $22 million loan guarantee from the Yukon Government, was to reopen Curragh's Faro Mine and mill complex in the Yukon Territory with waste stripping of the Grum ore body. The ore body contains more than 25 Mmt of reserves grading 2.96% lead, 5.01% zinc, and 50 g/mt silver. The new investors were to own 50% of the restructured Curragh, subject to a reduction to 43.5%. Korea Zinc has been one of Curragh's largest customers. Cominco Ltd. (25%) and Teck Corp. (25%) of Canada own the balance of Curragh's lead-zinc properties. The investment agreement depended on Curragh's ability to raise an additional $19 million and obtain a competitive power contract from Yukon Energy Corp.

In September, Curragh rejected the additional investment proposals made by the two Korean companies.

Industrial Minerals

Cement.—The Republic of Korea's cement industry was the fifth largest in the world, after those of China, the former U.S.S.R., Japan, and the United States. Total installed capacity grew 16.9%, but demand fell 1.6% in 1993. Excess cement supply reached 2.5 Mmt. Tong Yang Cement's new Samchok plant, with a capacity of 2.5 Mmt/a, was completed in January.

Daewoo Corp. began to build a $300 million, 2.4-Mmt/a cement plant in Shandong, China, in October with completion scheduled for June 1996. The cement would be exported to Japan and Southeast Asian countries. Meanwhile, Ssangyong Cement and Onoda Cement, Japan's largest cement manufacturer, agreed to cooperate in management and technical areas. The two were to focus on an internationalization strategy and make joint efforts to advance into third countries.

Graphite.—The Republic of Korea is a major producer of graphite, especially amorphous graphite. Graphite deposits are in the Provinces of Kang Won Do, Kiong Sang Puk Do, and Shung Chong Puk Do. Reserves of amorphous graphite were estimated to be 2.5 to 3 Mmt grading 75% carbon and those of crystalline flake graphite to be 1 to 1.5 Mmt averaging 80% carbon.

Silica.—Ssangyong Corp. was to participate for 10 years in a large-scale silica development project near Cam Ranh in Vietnam. Silica reserves were estimated to be 7 Mmt. The company sold $1 million worth of mining equipment to Vietnam and planned to mine 300,000 mt/a of silica. Silica was to be provided to the domestic Korean glass industry and account for one-half of the country's annual consumption. At present, most of the silica is imported from Australia.

Mineral Fuels

The use of renewable energy was to increase from the current 0.6% of total energy consumed to 3% by the year 2001. Confirmed potential resources of substitute energy amounted to 2.82 billion tons oil equivalent, with 19.6 Mmt oil equivalent possible from renewable resources using current technology.

Coal.—The Republic of Korea does not have bituminous coal resources and had to import 13 Mmt/a of steam coal to fuel its powerplants. Australia accounted for 57% of the tonnage imported; Canada, 21%; the United States, 11%; Russia, 5%; and China and the Republic of South Africa, both 3%. Korea Electric Power Corp.'s (KEPCO) requirements for steam coal were 10 Mmt and would be 17 Mmt in 1996. In addition, KEPCO also operated five coal-fired plants that consumed 2 Mmt/a of low-grade domestic anthracite.

Natural Gas.—The Ministry of Trade and Industry reported the discovery of a layer of good-quality natural gas in block 06-1 on the continental shelf, 43 km southeast of Ulsan. The gas layer was estimated to have a maximum reserve of 5.6 Mmt.

Korea Gas Co. signed a contract with Indonesia to import an extra 1.456 Mmt of liquefied natural gas for 1993 in addition to the 4.2 Mmt under long-term contract. Of the extra amount, 224,000 tons was to be delivered in the last 2 months of the year.

Petroleum.—Imports of crude oil rose to 694 Mbbl compared with 646 Mbbl in 1992. Hyundai Corp., which already owns 48.9% interest in the ailing refiner, took control of Kukdong Oil, the country's fifth largest oil refiner. The country's oil refineries produced 503 Mbbl of petroleum products.

Reserves

The Republic of Korea is a mineral resource-poor country. Anthracite coal is the most important mineral commodity. Indigenous metallic minerals include ores of lead and zinc and tungsten. Mining of the latter ceased because of market competition and world prices. Several industrial minerals with a large share of world production include diatomaceous earth, feldspar, graphite, mica, pyrophyllite, and talc.

INFRASTRUCTURE

Infrastructure is well developed and very efficient, but clogged transportation arteries were a major hindrance to economic development. The Government runs the railroads, which have a total length of 3,110 km. National highways measure 13,400 km while Provincial and local roads total 49,500 km. Expanded road and rail links around Seoul and Pusan were planned. Construction began on a new high-speed rail line between these two cities. The country's port facilities are adequate for raw material shipment as well as product export. Kwangyang Port serves to handle iron ore for Posco, whereas Pyongtaek Port is used as a liquefied natural gas import terminal. Pusan is the largest port among a total of 11, and Inchon is the largest on the west coast. Infrastructure development is important to future export competitiveness of the country's economy. The Government spent $5.7 billion on infrastructure in 1993.

The country's current power generating capacity stood at 21,200 MW. The cost of developing new powerplants weighed heavily on KEPCO. As part of its deregulation, the Government sold more of KEPCO, in which it held a 77% stake, and allowed private companies to compete with KEPCO.

OUTLOOK

The country's steel industry looks for a positive position in 1994 with domestic consumption expected to increase to 27.5 Mmt, an 8.2% increase. Strong growth in automobile, public works, and shipbuilding will contribute heavily to the increase. On the other hand, domestic production is expected to increase by only 1 Mmt to 34 Mmt. As Posco completed its capacity expansion, additional production capacity is to come mainly from the minimill sector, which accounted for 33% of the total steel

production, or 11 Mmt. Meanwhile, steel imports will increase to 4.6 Mmt and exports will decrease to 11.1 Mmt.

A new era of internationalization and cooperation is upon the steel industry with emphasis on deregulation, liberalization, quality, and innovation. The industry's efforts to stay competitive will continue with rationalization of facilities and cost-effective production.

[1]Where necessary, values have been converted from Korean won (W) to U.S. dollars at the rate of W806=US$1.00 for 1993.

OTHER SOURCES OF INFORMATION

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TABLE 1
REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Aluminum, primary		17,500	2,000	r—	r—	—	17,500
Bismuth metal		96	79	42	9	5	135
Cadmium, smelter e		500	500	450	620	400	—
Copper:							
Mine output, Cu content		4	53	5	e4	5	—
Metal:							
Smelter		179,890	185,563	e202,000	e210,000	220,000	225,000
Refined, primary		178,665	e183,000	201,911	209,000	218,000	225,000
Gold metal	kilograms	14,270	20,760	20,809	23,263	25,000	—
Iron and steel:							
Iron ore and concentrate:							
Gross weight	thousand tons	334	298	222	222	2219	—
Fe content	do.	187	180	134	134	2122	—
Metal:							
Pig iron	do.	14,846	15,339	18,510	19,323	22,000	—
Ferroalloys:							
Ferromanganese		85,329	r83,963	94,893	85,867	99,000	—
Ferrosilicon		4,582	2,000	18,912	18,198	3,000	—
Ferrosilicomanganese		87,105	82,763	74,173	82,582	84,000	—
Other		r14,713	r16,115	r—	r—	—	—
Total		191,729	r184,841	187,978	186,647	186,000	—
Steel, crude	thousand tons	21,873	23,125	26,001	28,054	33,000	35,000
Lead:							
Mine output, Pb content		16,535	14,857	12,633	13,628	214,818	—
Metal, smelter		e60,000	e61,000	40,554	63,000	88,000	95,000
Molybdenum, mine output, Mo content		132	103	144	—	—	—
Silver metal	kilograms	239,214	238,236	264,746	332,791	330,000	—
Tungsten, mine output, W content		1,701	1,361	780	247	200	3,000
Zinc:							
Mine output, Zn content		23,202	22,792	22,039	21,883	227,616	—
Metal, primary		240,184	248,244	254,050	253,000	272,000	240,000
INDUSTRIAL MINERALS							
Asbestos		2,361	1,534	e1,500	2,308	2,200	—
Barite		3,735	2,923	1,014	40	50	—

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Cement, hydraulic	thousand tons	30,474	33,600	34,999	42,650	47,000	50,000
Clays: Kaolin		1,219,174	1,446,598	1,755,225	1,856,157	[2]2,328,921	—
Diatomaceous earth		75,019	55,445	91,126	76,775	[2]67,324	—
Feldspar		232,607	237,447	247,969	281,553	[2]539,169	—
Fluorspar, metallurgical-grade		856	560	290	70	[2]50	—
Graphite:							
Crystalline		1,186	703	1,552	8,412	[2]5,910	—
Amorphous		100,282	98,987	75,239	r75,000	72,000	—
Total		101,468	99,690	76,791	r83,412	77,910	—
Kyanite and related materials: Andalusite		19	—	14	38	30	—
Mica: All grades		7,888	4,765	5,127	7,732	7,500	—
Nitrogen: N content of ammonia		480,310	411,287	407,297	442,482	450,000	—
Salt		830,000	616,681	695,804	771,937	750,000	—
Soda ash, manufactured e		280,000	280,000	300,000	300,000	310,000	—
Stone, sand and gravel:							
Limestone	thousand tons	48,011	48,851	59,221	65,446	[2]76,886	—
Quartzite	do.	1,554	1,452	1,627	1,870	[2]2,510	—
Sand including glass sand	do.	1,358	1,408	1,354	1,266	[2]1,117	—
Sulfur, byproduct:							
Metallurgy	do.	221	221	229	260	263	—
Petroleum	do.	28	65	65	100	200	—
Total	do.	249	286	294	360	463	—
Talc and related materials:							
Pyrophyllite		770,298	657,611	573,208	602,580	[2]644,890	—
Talc		162,098	181,600	170,563	149,862	[2]53,923	—
MINERAL FUELS AND RELATED MATERIALS							
Carbon black		193,358	215,300	231,000	246,000	300,000	—
Coal: Anthracite	thousand tons	20,785	17,217	14,850	11,970	[2]9,443	—
Coke e	do.	5,500	5,500	5,600	5,600	5,800	—
Fuel briquets: Anthracite briquets		18,700	18,779	14,996	11,069	12,000	—
Petroleum refinery products:							
Gasoline	thousand 42-gallon barrels	18,309	23,984	28,917	r30,000	38,000	—
Jet fuel e	do.	9,600	9,600	9,700	9,700	9,800	—
Kerosene	do.	13,161	13,873	14,523	r15,000	29,000	—
Distillate fuel oil	do.	88,577	94,814	128,379	r130,000	165,000	—
Residual fuel oil	do.	100,320	98,634	142,443	r145,000	180,000	—
Lubricants e	do.	7,400	7,400	7,500	7,500	4,200	—
Other e	do.	16,000	17,000	18,000	19,000	17,000	—
Refinery fuel and losses e	do.	4,000	4,000	4,000	4,000	4,000	—
Total e	do.	257,367	269,305	353,462	360,200	447,000	—

eEstimated. rRevised.

[1]Includes data available through Mar. 15, 1994.

[2]Reported figure.

TABLE 2

REPUBLIC OF KOREA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons per year)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum, primary	Aluminium of Korea Ltd.	Ulsan	18
Bismuth, metal	Korea Tungsten Mining Co. Ltd.	Sangdong	0.135
Cement	Ssangyong Cement Industrial Co. Ltd.	Yongwol	11,500
Copper, metal	Lucky Metals Ltd.	Changhang	50
Do.	do.	Onsan	175
Graphite	Kaerion Graphite Ltd.	Kangwon	25
Do.	Wolmyong Mining Co.	do.	26
Lead, metal	Lucky Metals Co. Ltd.	Changhang	(1)
Do.	Korea Zinc Co. Ltd.	Onsan	150
Nickel, metal	Korea Nickel Corp.	do.	12
Steel	Pohang Iron and Steel Co. Ltd. (35% Government owned)	Kwangyang	11,400
Do.	do.	Pohang	9,400
Talc	Dongyang Talc Mining Co.	Chungju	NA
Tungsten, in ore	Korea Tungsten Mining Co. Ltd.	Sangdong	3
Zinc, metal	Korea Zinc Co. Ltd.	Onsan	170
Do.	Young Poong Corp.	Sukpo	75

NA Not available.
[1]Closed in 1990.

TABLE 3

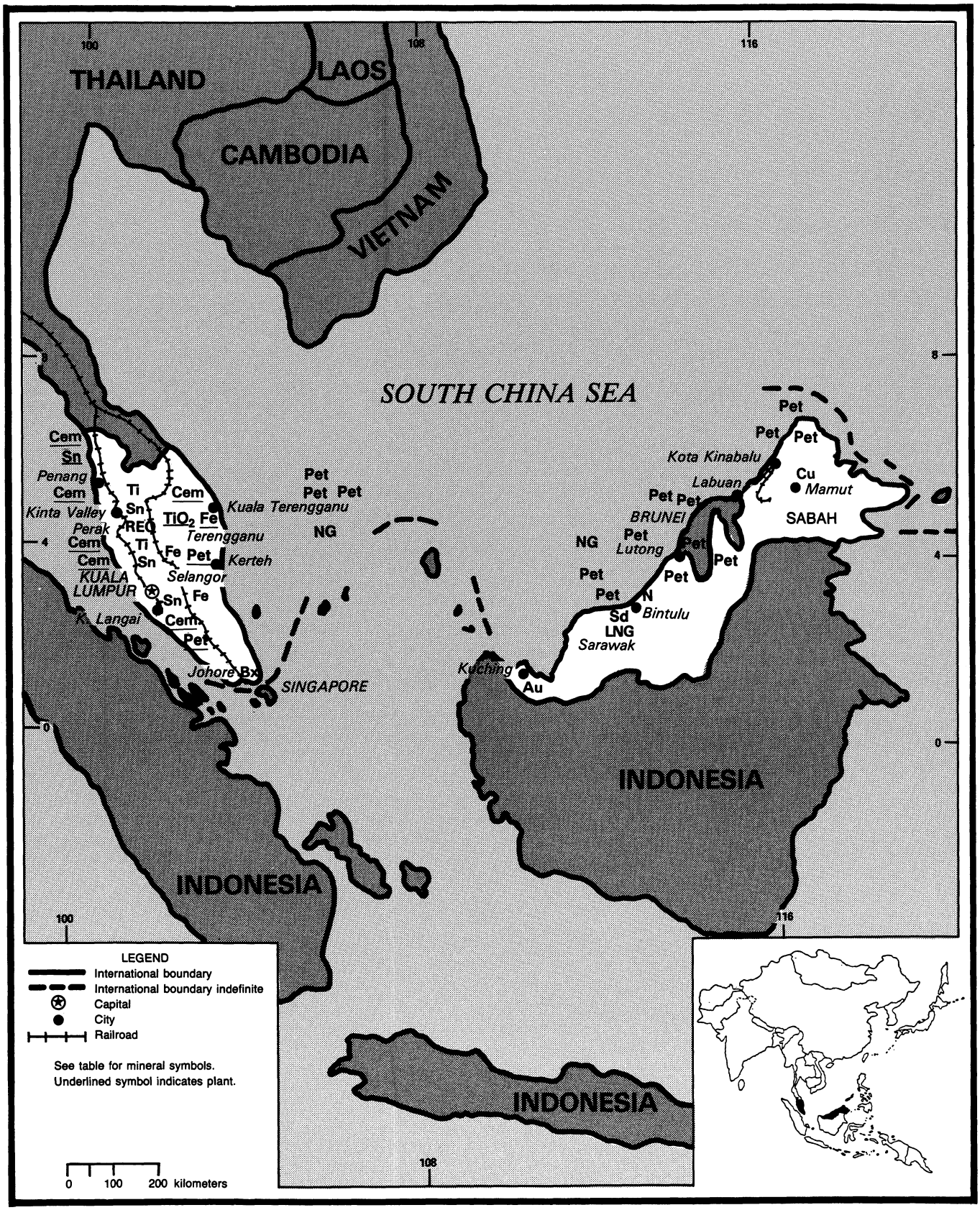
REPUBLIC OF KOREA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1993

(Thousand tons)

Commodity	Reserves
Bismuth	4
Coal, anthracite	1,450,600
Graphite	39,500
Pyrophyllite and talc	15,000
Tungsten	60
Zinc, in ore	10,800

MALAYSIA

AREA 329,750 km² **POPULATION 18.8 million**



THE MINERAL INDUSTRY OF

MALAYSIA

By John C. Wu

Malaysia's important mineral resources include bauxite, clays, copper, ilmenite, iron ore, natural gas, petroleum, rare earths, and tin. Of these minerals, only its tin reserves are large and are ranked the world's third largest after China and Brazil. In recent years, copper and gold deposits were discovered along the Central and Eastern Belts in Peninsular Malaysia, the Central Belt in Sabah, and in the western part of Sarawak.

According to the Geological Survey of Malaysia, two Cyprus-type massive sulfide copper deposits containing considerable amounts of gold and silver in the areas of Bidu-Bidu Hills of Sabah were expected to be developed in the next 2 years. There are other copper mineralizations still under investigation. Mineralization of copper, lead, and zinc association with considerable amount of gold and silver had been discovered in the Ulu Sokor area of northern Kelantan; in the Sungai Lebir and Gua Setir areas of Kelantan; in the Kuala Lipis, Raub, Sungai Lepar, and Chini areas of Pahang; in the Pingan-Pingan, Bambangan, Nungkok, Karangan, and Karamuak areas of Sabah; and in the Bukit Jebong-Biawak, Kendaii, Bau, Gunung Buri, Bukit Pan, and Bukit Nimong areas of Sarawak.

Malaysia, once the world's largest tin producer, ranked fifth in mine production of tin, but remained first in refined tin production in 1993. Malaysia was the world's third largest liquefied natural gas (LNG) producer and an important producer of bauxite, copper, crude petroleum, ilmenite, kaolin, monazite, natural gas, and zircon in Southeast Asia in 1993. The mining industry, which contributed about 8% to Malaysia's gross domestic product (GDP), remained an important sector of the economy, but grew little in 1993 because of decreased production of most nonfuel minerals and crude petroleum except coal and natural gas.

According to Malaysia's Department of Statistics, the output of the mining industry grew only 0.7% in 1993 compared with 2.7% in 1992, while Malaysia's GDP grew 8.5% in 1993 compared with 7.8% in 1992. Malaysia's GDP in 1978 constant dollars was estimated at $39.2 billion,[1] of which about $3.1 billion was contributed by the mining industry in 1993. Malaysia exported most of its mineral products to Japan and neighboring Southeast Asian countries. Malaysia was an important supplier of copper, ilmenite, natural gas, crude petroleum, rare earths, and refined tin to Japan. The relative importance of Malaysia for supplying crude petroleum, rare earths, and refined tin to the United States had diminished when U.S. imports of these commodities from Malaysia decreased considerably since 1991.

Malaysia remained a net exporter of mineral products in 1993. Malaysia exported all of its copper concentrate, ilmenite, rare earths, and zircon concentrate production; between 80% and 85% production of its smelted tin, silica sand, and natural gas production; and about 70% of its coal and crude petroleum production in 1993. Export earnings were estimated at $47.1 billion in 1993, of which $3.1 billion was from exports of crude petroleum and about $1 billion from exports of natural gas (in the form of LNG). Malaysia's imports of nonfuel minerals, such as iron ore and tin concentrate, were mostly reexported after smelting. However, a considerable quantity of coal; heavy crude petroleum; nonferrous metals; and industrial minerals, including gypsum, phosphate rock, potash, and salt, were imported annually for domestic consumption.

GOVERNMENT POLICIES AND PROGRAMS

In an effort to assist the depressed mining industry and to promote the development of the mining industry, the Government had adopted numerous changes to its tax law and provided various fiscal incentives. To help mining companies to overcome financial difficulties, the Government eliminated the export duty, which ranged from 10% to 15%, for all minerals and concentrates except gold. To encourage local jewelry production, the Government abolished a 5% import duty on gold bullion and coins effective July 1, 1993. The import duty imposed by the Government on gold was reduced to 5% in 1992 from 10% in 1991.

To boost the production of mineral products, the following fiscal incentives were provided by the Government: (1) development tax reduction, from 4% to 3%, (2) a 50% tax cut on income earned from mining investment overseas and remitted back to Malaysia, (3) a 40% reinvestment allowance provided to companies that incurred capital investment in plant and machinery on Government-approved projects between 1991 and 1995, (4) dividends paid from the tax exempt income exempted from income tax for the first 5 years of profitable operations, (5) mining companies allowed to deduct from income their expenditures on market research and other preoperational cost items on Government-approved projects, and (6) double deduction incentives for export promotion and training, and Incentives for Research and Development.[2]

PRODUCTION

The oil and gas industry continued to dominate the mineral industry of Malaysia in 1993. The output of crude petroleum declined, and natural gas production reached a record high in 1993. The tin industry suffered from record low tin prices on the Kuala Lumpur tin market (KLTM), and its employment reached a record low in 1993. Because of a record low tin production, the output of byproducts such as ilmenite, monazite, and zircon dropped sharply. The output of washed bauxite and iron ore declined in 1993 owing to reduced exports, while the decline in the production of copper was due to poor ore grade and weak copper prices. The production of gold and silver increased in 1993 because of increased output from newly opened mines in Peninsular Malaysia and Sarawak. Production of barite and silica sand decreased, and production of cement, kaolin, and mica reached a record high in 1993 because of stronger demand in the domestic market. *(See table 1.)*

TRADE

Malaysia remained a minerals net exporting country. In 1993, Malaysia's export earnings of crude petroleum and natural gas in the form of LNG totaled $4.1 billion, accounting for about 96% of the total mineral export earnings and about 9% of the country's total merchandise exports. Export earnings from crude petroleum and LNG decreased in 1993 because of lower oil and gas prices in the world market. Export earnings from refined tin were $190 million in 1993, compared with $283 million in 1992.

Malaysia continued to import about 23,000 bbl/d of heavy crude petroleum from the Middle East to meet the requirement for domestic refineries. Other important minerals imports in 1993 were cement, gypsum, iron ore, phosphate rock, potash, sodium carbonate, sulfur, and tin concentrate (for reexport after smelting) for domestic consumption.

STRUCTURE OF THE MINERAL INDUSTRY

The structure of Malaysia's mineral industry remained unchanged in 1993. However, the output capacity of the oil and gas industry continued to expand, while capacity of the tin industry contracted further in 1993. In the industrial minerals sector, the cement industry capacity was expanded to about 9 Mmt/a, after Tasek Cement Bhd. brought on-stream its 2,000-mt/d-capacity plant in Ipoh, Perak, in 1993.

According to an estimate by the Malaysian Ministry of Human Resources, the total number of persons employed by the mining and quarrying industry decreased to 35,000 in 1993 from 36,300 in 1992. According to the Malaysian Department of Mines, the number of workers employed by the major nonfuel minerals industries at the end of 1993 was 50 in barite, 166 in bauxite, 1,118 in copper, 555 in gold, 139 in iron ore, 436 in kaolin, 176 in silica sand, and 2,296 in tin. Additionally, there were 227 workers involved in limestone quarrying and 117 coal miners in 1993. Malaysia's total labor force rose from 7.4 million in 1992 to 7.6 million in 1993, while the unemployment rate decreased from 3.9% in 1992 to 3.6% in 1993 mainly owing to increased employment in the construction, manufacturing, and service industries. *(See table 2.)*

COMMODITY REVIEW

Metals

Aluminum and Bauxite.—Mine production of bauxite dropped sharply in 1993 because of a drastic reduction in exports to Japan and the United States. Johore Mining and Stevedoring Co. Sdn. Bhd., Malaysia's sole bauxite producer, operated a multiple-bench, open pit mine and a washing plant with a capacity of 1 Mmt/a of ore and a work force of 170 at Bukit Raja, around Pengerang Highway north of Sungai Rengit, east of Johore Bahru. The company produced three grades of bauxite: refractory-grade, metallurgical-grade, and cement-grade. Most chemical- and metallurgical-grade washed bauxite was exported, while the cement-grade bauxite was sold as raw material to the domestic cement manufacturers. Exports of bauxite declined from 198,200 tons in 1992 to less than 62,900 tons in 1993. Export earnings from bauxite were valued at $1.2 million in 1993, compared with $3.2 million in 1992.

Johore Aluminium Processing Sdn. Bhd. reportedly completed construction of its 7,500-mt/a secondary aluminum smelter in late 1993. The company was expected to begin its smelting operation with an initial output of 5,000 mt/a in early 1994. The technology and equipment, including a 6-ton converter and a 16-ton holding furnace, were supplied by Kuusakoski Oy (KO) of Finland. The aluminum scrap feed for the smelter, such as aluminum turnings, spillings, casting, and sheet, will be collected locally, while other scrap feed, such as nonmagnetic fraction scrap and mixed-metal feed, will be imported from Australia, Europe, Japan, Singapore, and the United States. The joint venture is 35% owned by Johor State Economic Development Board; 27.5% each by KO and Finfund (the Finnish Government's Industrial Development Corp.); and 5% each by Nakadaya Co. of Japan and Celtrad Metal Industries of Singapore.[3]

Copper.—Production of copper concentrate by Mamut Copper Mining Sdn. Bhd. from the Mamut Mine in Sabah decreased to about 100,129 tons from 111,593 tons in 1992 because of declined ore grade. The average content of copper in the concentrate was 25.1%, compared with 25.6% in 1992. The content of gold and silver in the concentrate was 20.40 g/mt and 136.46 g/mt, respectively, in 1993 compared with 19.85 g/mt and 135.10 g/mt, respectively, in 1992. The metal content of copper, gold, and silver in the concentrate was 25,182 tons, 2,042.4 kg, and 13,663.3 kg, respectively, in 1993. According to Mamut Copper Mining, the

copper mining operation could be shut down by mid-1997 because of poor ore grade and low copper prices. The remaining reserves at the Mamut Mine reportedly were at the deeper level with lower grade ore.

Gold.—Gold production increased considerably in 1993 mainly owing to increased production, mainly in the Tebedu area of southwestern Sarawak. Of the total gold produced in 1993, 46% was from the Mamut copper mine in Sabah; 19% was from 14 to 20 small-scale mines mainly in the States of Kelantan, Pahang, and Terengganu; and 35% from 2 gold mines in Sarawak.

Malaysia imported more than 100 tons of gold, including semifabricated annuals for consumption by its growing jewelry industry. In the past 2 years, about 70 tons of gold jewelry had been exported annually. To encourage local jewelry production for export, the Government abolished a 5% import duty on gold bullion and coins effective July 1, 1993.

In late 1993, Avocet Ventures of the United States announced that, as a result of its continued exploration, more gold mineralization was discovered on its Penjom gold property in Pahang. According to its 1993 drilling program, gold had been identified in a 50-m-wide area. The 1993 drilling results showed an average width of 13 m with grades ranging from 1 g/mt to 13 g/mt of ore. The company is to continue its drilling program in early 1994.[4]

Iron and Steel.—Iron ore production decreased when exports of iron ore dropped in 1993. According to the Malaysian Department of Mines, exports of iron ore totaled about 52,000 tons valued at $677,400 in 1993, compared with 248,580 tons and $3.8 million in 1992. In 1993, most iron ore was produced from eight small deposits in the States of Johore, Kedah, Pahang, Perak, and Terengganu. During the second half of 1993, only three to five mines were producing at less than 50% capacity. In 1993, about 20,000 tons of iron ore was produced as a byproduct of tin mining.

To meet domestic requirements for its iron and steel industry, Malaysia imported about 1.2 Mmt/a of iron ore and pig iron, principally from Brazil and Chile, and about 1 Mmt/a of iron and steel scrap from the United Kingdom and the United States. Most of the imported iron and steel scrap was consumed by Perwaja Terengganu Sdn. Bhd. (PTSB), the State-owned steel company, while most imported iron ore was consumed by direct-reduced iron (DRI) plants in Kemaman, Terengganu, and on Labuan Island, off Sabah.

PTSB completed renovation of its DRI plant with two HYL-III-process modules at its Telok Kalong site in Kemaman, Terengganu. The 1.2-Mmt DRI plant began operation, using mostly imported iron ore from Chile in late 1993. PTSB also operated three electric arc furnaces using imported ferrous scrap and produced between 1 Mmt and 1.2 Mmt of steel billets in 1992 and 1993. About 30% of its annual output was exported. The company reportedly earned a pretax profit of about $14 million in the fiscal year ended in March 1993. Since 1985, PTSB had accumulated debt and losses of about $1 billion.[5]

Steelcorp Sdn. Bhd., established jointly by Amalgamated Steel Mill (ASM), Malayawata Steel (MS), and Southern Iron and Steel Works (SISW) in 1992, operated a DRI plant and produced about 600,000 tons of hot-briquetted iron. About 80% of its output was exported mainly to Indonesia, Italy, and the Republic of Korea. The remaining output was consumed by the three equityholders.

Rare Earths.—Crude rare earths have been produced by Asian Rare Earth Ltd. (ARE) near Bukit Merah, about 6 km southwest of Ipoh in Perak, since 1982. The plant processed monazite for the production of rare-earth chloride and rare-earth carbonate for export, mainly to Japan and the Eurpean Community (EC). In past years, the plant produced about 2,000 tons of rare-earth chloride and 1,200 tons of rare-earth carbonate using domestic and import monazite as raw material. Operations of the rare-earth plant had been halted since July 1992 because of a July 1992 ruling by the High Court in Ipoh against the company.[6]

In processing monazite to produce crude rare earths, the plant also produced a low-level radioactive thorium hydroxide as byproduct. In October 1985, nearby Bukit Merah residents filed a civil suit to stop ARE from operating until proper safety measures were taken to prevent escape of the radioactive gases from the plant. The plant was shut down for more than 1 year, but ARE resumed operation in February 1987, claiming that it had complied with the safety measures, because the low-level waste was stored at a nearby site in Mukim Belanja.

In December 1993, the Supreme Court of Malaysia in Kuala Lumpur overturned a July 1992 ruling by the High Court in Ipoh, ordering a complete closure of the plant on the grounds that the plant was producing and storing radioactive waste and was endangering the health of nearby residents by releasing highly dangerous radioactive gases into the air. The Supreme Court ruled in December 1993, in favor of an appeal by ARE requesting to continue operations, that the High Court in Ipoh erred in giving preference to scientific evidence produced by the plaintiffs, who had not exhausted all other means of closing the plant.[7]

Tin.—Malaysia's tin mining industry contracted further in 1993 because of a prolonged tin price slump on the world market, increased labor and equipment costs, depleting high-grade tin ore, and withdrawal of Malaysia Mining Corp. (MMC) and three other major mining companies from tin mining. As a result, the 1993 mine output of tin dropped to a new low in Malaysia's post-World War II tin mining history. Of the tin produced in 1993, 35% was by dredging, 33% by gravel pumping, 15% by open pits, 10% by panning, and 8% by amang retreatment and underground mining.

According to Malaysia's Department of Mines, the monthly output of tin decreased to 582 tons in December 1993 from 1,201 tons in December 1992. The total number of operating mines decreased to 43 in December 1993 from 63 in December 1992. The tin mining

industry's total labor force declined to 2,296 in December 1993 from 4,672 in December 1992. During 1993, the dredging sector shut down 8 dredges and laid off 1,192 workers and the gravel-pumping sector closed 4 mines and laid off 388 miners. Most of the laid off tin miners reportedly were able to find jobs in the growing manufacturing and construction industries.

MMC, once the world's largest tin producer, announced that it would cease all tin mining operations in Malaysia in the second half of 1993 because it incurred 3 consecutive years of losses resulting from the prolonged tin price slump on the KLTM and the gloomy outlook in the short- and medium-term. In July, two MMC subsidiaries, Tronoh Mines Malaysia Bhd. and Kramat Tin Dredging Bhd., were to cease their tin mining operations in Malaysia after suffering continuous losses. Berjuntai Tin Dredging Bhd., which decided to scale down its tin mining operations in September, announced at yearend that it also would cease tin mining in Malaysia in 1994. Berjuntai Tin Dredging was one of the oldest tin mining companies in Malaysia.

In 1993, Rahman Hydraulic Tin Bhd., Petaling Tin Bhd., and Timah Langat Bhd., three remaining medium-size, low cost tin producers, continued to operate with a profit. Rahman Hydraulic operated an open pit mine with a capacity of about 1,200 mt/a at Klian Intan in the northern part of Perak near the Thailand border, while Petailing Tin and Timah Lagat operated high-capacity tin dredges with a capacity of 1,500 mt/a and 1,200 mt/a, respectively, in the Kuala Langat District of Selangor with good quality sand and clays as byproducts of their tin mining.

Production of tin metal by Datuk Keramat Smelter Bhd. and Malaysia Smelting Corp. Bhd. decreased in 1993 because of the shortage of domestic raw material. To supplement the shortage and better utilize their smelting capacity, both smelters continued to import about 48,702 tons of tin concentrate containing 27,277 tons of metal in 1993, compared with 58,638 tons containing 33,147 tons of metal in 1992, mainly from Australia, Bolivia, China, Indonesia, and the United Kingdom. Both smelters had invested on equipment in recent years to treat imported lower grade ore, especially from China.

Malaysia exported 35,545 tons of refined tin, compared with 45,150 tons in 1992. The major buyer of Malaysia's refined tin in 1993 was Japan, which imported 8,290 tons compared with 9,417 tons in 1992. The other buyers in 1993 were the Republic of Korea, 4,627 tons; the Netherlands, 4,285 tons; Taiwan, 3,775 tons; and the United Kingdom, 3,643 tons. Exports of refined tin to the United States declined from 6,624 tons in 1990 to 2,214 tons in 1992 and 1,527 tons in 1993. Export earnings of refined tin declined to $190 million in 1993 from $283 million in 1992.

According to the Malaysian Department of Mines, domestic demand for refined tin rose by 22% to 5,196 tons in 1993 because of increased consumption by the solder industry. Of the total domestic tin consumption, 2,940 tons was consumed by the solder industry, 802 tons by the tinplating industry, 544 tons by the pewter industry, and 910 tons by other industries.

Industrial Minerals

Cement.—Malaysia's cement production reached a new high in 1993 because of increased demand by the construction industry as Malaysia continued to invest heavily in its infrastructure development, office buildings, and residential housing projects. Malaysia has nine cement plants, of which seven were in peninsular Malaysia and two (grinding plants) in east Malaysia. In 1993, the industry's total clinker capacity was estimated at 10.2 Mmt/a. Limestone for the manufacturing of cement was supplied by local limestone quarries operated mainly in peninsular Malaysia, at Kinta of Perak, at Langkawi of Kedah, and at Puchong of Selangor. Consumption of limestone by the cement industry was estimated at 11 Mmt in 1993.

According to the Cement and Concrete Association of Malaysia, Malaysia's cement production was expected to grow by 12% to 10.2 Mmt in 1994. This higher projection on cement production was based on the anticipated strong domestic demand for the construction of public works projects, commercial buildings, and residential housing in 1994.

Titanium.—Most ilmenite concentrate was recovered as a byproduct from tin tailing treatment plants operating in the States of Perak and Selangor. Production of ilmenite concentrate declined substantially in 1993 because of the cutback in tin mining operations of MMC and Berjuntai Tin Dredging in the States of Perak and Selangor. Exports of ilmenite concentrate dropped to 142,737 tons in 1993 from 157,922 tons in 1992. Export earnings of ilmenite concentrate were valued at about $10.1 million in 1993.

Tioxide (Malaysia) Sdn. Bhd., a joint-venture of the Tioxide Group PLC (85%) of the United Kingdom and the Terengganu State government and local residents (15%), began production of titanium dioxide pigment in 1992. Production of titanium dioxide pigment was 22,854 tons in 1993. The plant has a capacity of 50,000 mt/a of titanium dioxide using the sulfate process at Telok Kalong near Kemaman, Terengganu. In past years, about 80% of the raw material was imported from Australia and the remainder was supplied by local producers.

Mineral Fuels

Coal.—Coal production rose substantially owing to increased productivity. Global Minerals Sarawak (GMS), the sole producer, operated an open pit mine at Beradai in the Merit-Pila area near Kapit in Sarawak with about 120 workers. During 1993, the mine was sold by GMS to Pan Global Equities for $78 million. The proven coal reserves in the Merit-Pila area were recently estimated at 440 Mmt. The open pit mine planned to produce 720,000 mt/a of

coal, of which 90% would be sold to the National Electricity Board for power generation. The underground coal mine at Silantek in the Semantan area, about 100 km southeast of Kuching in Sarawak, had been shut down since April 1991 because of operational problems. According to the Geological Survey of Malaysia, active exploration for coal had been conducted by Buroi Mining Sdn. Bhd. (BMS) in the Mukah-Bakingian area of Sarawak and by Broken Hill Proprietary in the eastern Maliau Basin of Sabah. Coal reserves of 51 Mmt reportedly had been proven in the Mulkah-Balingian area.

Malaysia continued to import about 2 Mmt of coal, including anthracite, bituminous, and lignite, to meet its domestic requirements for metals smelting, cement manufacturing, and power generating. Malaysia's annual coal import bills were about $100 million.

Natural Gas.—Natural gas production, including associated gas and nonassociated gas but excluding reinjected and flared, rose to a record-high level in 1993 owing to increased output from offshore Terengganu by Esso Production Malaysia Inc. (EPMI) and from offshore Sarawak by Sarawak Shell Bhd. (SSB).

During 1992-93, a significant gas discovery was made by Occidental Petroleum Corp. (37.5%) of the United States in partnership with Nippon Oil Co., Ltd. (37.5%) of Japan and PETRONAS (25%), the State-owned oil and gas company, on block SK-8, offshore Sarawak. The Jintan-1 wildcat on block SK-8 tested 931.6 m^3/d of high-quality gas and 832 bbl/d of condensate. The outpost Jintan-2 yielded 1,823.6 m^3/d of gas and 620 bbl/d of condensate. The Selasih-1 exploratory well, 113 km southeast of the Jintan, tested 1,186.5 m^3/d of gas and 283 bbl/d of condensate. The Serai-1, the last of a four-well program on block SK-8, tested 3,766.1 m^3/d of gas and 2,262 bbl/d of condensate. Reserves in the concession area were estimated at 113.3 Bm^3 of gas and 75 Mbbl of condensate.[8]

To utilize gas resources from the Jintan gasfield on block SK-8 and the Layang gasfield, discovered by Nippon Oil in 1992, on block-10 adjoining block-8, PETRONAS and its partners began conducting the feasibility study of building Malaysia's third LNG plant in 1993. Combined gas reserves of the SK-8 and the SK-10 blocks were estimated at 141.6 Bm^3.

LNG production by Malaysia LNG Sdn. Bnd. (MLNG) in Bintulu, Sarawak, rose to 9.2 Mmt in 1993 from 8.8 Mmt in 1992. PETRONAS, the State-owned oil and gas company, awarded a $1.6 billion contract to a consortium of M.W. Kellogg Co. of the United States, JGC Corp. of Japan, and Sime Engineering Sdn. Bhd. of Malaysia in 1992 for building Malaysia's second LNG plant, to be operated by Malaysia Liquefied Natural Gas Dua Sdn. Bhd. (MLNG-2) at the existing Bintulu LNG plant in Sarawak. The contract called for engineering, procuring, and building three new LNG trains to double the production capacity of the Bintulu LNG plant to 16 Mmt/a. Construction work on the expansion was expected to be completed by 1995 and begin commercial operation in 1996.

Exports of LNG by MLNG totaled about 9 Mmt and were valued at about $1 billion in 1993. About 95% of the LNG exports went to three Japanese utility companies, Tokyo Electric Power Co., Tokyo Gas Co., and Saibu Gas Co., and the remaining exports went to the Republic of Korea.

The Peninsular Gas Utilization (PGU-II) project, the second and third 7-Mm^3/d gas processing plants at Telok Kalong near Kertek in Terengganu, the upgrading and expanding of the Kertek export terminal facilities, and the ethane extraction facilities had been completed. According to industry sources, the PGU-II was fully operational and successfully supplying processed gas to powerplants at Pasir Gugang in Johor, at Connought Bridge in Selangor, and the Senoko powerplant in Singapore.

The Government of Malaysia was evaluating documents for the Peninsular Gas Utilization project (PGU-III). The $1 billion PGU-III project involved construction of a 549-km pipeline network (451 km of trunkline and 98 km of lateral lines) for extending the existing 730-km gas pipeline (PGU-II) northward from Meru in Selqangor to Bukit Keteri in Perlis on the west coast near the border with Thailand. Studies were also in progress to extend the gas pipeline northward from Kertek on the east coast. The fourth 7-Mm^3/d gas processing plant under PGU-III was under construction by Stone and Webster of the United States in 1993.

Petroleum.—Malaysia's crude petroleum production, including condensate, declined from an average of 661,000 bbl/d in 1992 to 642,000 bbl/d in 1993. Crude petroleum production in 1993 was from 32 oilfields with 43 offshore platforms operated by PETRONAS Carigali Sdn. Bhd. (PETRONAS CAG), the upstream arm of PETRONAS, and three foreign contractors, EPMI, SSB, and Sabah Shell Petroleum (SSP). About 50% of the 1993 production was by EPMI from 13 oilfields, located offshore Terengganu. The remaining 50% was by SSP, SSB, and PETRONAS CAG from 19 oilfields, offshore the States of Sarawak and Sabah. Malaysia's crude oil production capacity, including condensate, remained at an average of 690,000 bbl/d in 1993.

Export earnings from crude petroleum declined by 11.4% to $3.1 billion in 1993 resulting from lower oil prices and decreased exports. Japan, the Republic of Korea, Singapore, and the United States remained the major buyers of Malaysian crude petroleum in 1993. Malaysia continued to import about 22,000 bbl/d of heavy crude oil in 1993 to meet the requirement of the domestic oil refineries.

In September, Mobil Oil Corp. of the United States signed two production-sharing contracts with PETRONAS to explore for oil and gas in a 1.3-Mha area on blocks A and B, about 282 km offshore from Sarawak. According to PETRONAS, since 1974, it had signed a total of 37 production-sharing contracts with 39 oil companies for onshore blocks and shallow offshore areas of less than

200 m deep. The production-sharing contracts it signed with Mobil Oil were the first involving high-risk exploration in deep water.

In May, Esso announced that through its affiliated companies, EPMI, Esso Malaysia Bhd., and Esso Borneo Sdn. Bhd., it will spend a total of $6.2 billion in Malaysia by the end of the decade or on average about $627 millon per year mostly on the exploration and on production facilities for the oil and gas it discovered in the past 2 to 3 years. On exploration, Esso discovered a gasfield, the Laho-1 in Malaya Basin, that tested 1,784 m^3/d of gas and 290 bbl/d of condensate in 1993. Esso planned to drill 25 wells in the next 2 years. On downstream, Esso was expected to expand its 58,000-bbl/d oil refinery in Port Dickson, Negeri Sembilan, to 75,000 bbl/d by 1995.

Following the withdrawal of Idemitsu Kosan Co. Ltd. of Japan from PETRONAS' PSR-2 project to build a 100,000-bbl/d sour crude refinery in Malacca, Conocol Inc. of the United States signed a letter of intent in May to work with PETRONAS on the basic engineering design and selection of process licensors for PSR-1. In December, PETRONAS and Conoco established a joint-venture firm, Malaysian Refining Co., to undertake the development and management of the $1.9 billion PSR-2 project. Construction of PETRONAS' wholly owned PSR-1 project for building a 100,000-bbl/d sweet crude refinery in Tangga Batu, Malacca, was expected to be completed in late 1994.

Reserves

Malaysia is estimated to have more than 15% of known world tin reserves. The estimated ilmenite and monazite reserves associated with tin reserves are substantial. Ore reserves of bauxite, copper, natural gas, petroleum, and other industrial minerals are small but considered significant for the area. Malaysia was ranked 22d in worldwide oil reserves and 14th in natural gas reserves. Reserves of major mineral commodities are shown in table 3, according to the Malaysian Government and industry sources. *(See table 3).*

INFRASTRUCTURE

Malaysia's existing highways, railroad system, and port facilities are adequate to transport most of the nonferrous mineral products to domestic and overseas markets. As part of PGU-II, construction of two new gas processing plants and upgrading of export terminals at Kerteh had been completed. A consortium formed by PETRONAS, two local companies, and two Japanese firms began construction of a gas-reticulation system covering the States of Selangor and Johore. The Government began design and engineering studies on construction of a 530-km gas pipeline network for extending the 730-km gas pipeline northward from Meru in Klang to Bukit Keteri in Perlis on the west coast of peninsular Malaysia and northward from Kertek on the east coast under the PGU-III project in 1993. Under the Government plan, the PGU-III project, which also included building one more new gas processing plant, was scheduled for completion in 1995 at an estimated cost of more than $1 billion.

To accommodate the transportation needs of the new growing industrial areas and in the southern Johore State, the 924-km North-South Expressway along the west coast of peninsular Malaysia connecting Thailand in the north and Singapore in the south was scheduled for completion in the first half of 1994. According to the Malaysian Highway Authority, Federal route No. 2 connecting Kuala Lumpur on the west coast to Kuantan on the east coast had been expanded. In Johore, construction of a new second bridge for crossing to Singapore and a 43-km highway linking the North-South Expressway to western Singapore had begun in 1993.

Malaysia's installed electricity capacity was 8,000 MW and produced about 30,000 MkW•h. Demand for electricity had been increasing at an average annual rate of about 11% as a result of the growing manufacturing sector during the past 5 years.

In 1993, the Government announced that it planned to build a new international airport at Sepang, about 48 km south of Kuala Lumpur at a cost of about $3.9 billion and a new city about 8 km north of the planned international airport. According to the Government, about 250,000 Government employees will be relocated to new offices to be built in the new city.

The Standards and Research Institute of Malaysia (SRIM) in Kuala Lumpur is to set up a center for chemical waste in cooperation of the Japan International Cooperation Agency (JICA). The center at SRIM is to evaluate, analyze, and biologically treat hazardous chemical wastes. JICA will finance the center and provide training for 18 Malaysian researchers and assistants in Japan.

OUTLOOK

The oil and gas industry will continue to dominate the mineral industry of Malaysia because of its contribution to the Malaysian economy. The crude petroleum production capacity will be raised to 750,000 bbl/d when EPMI and PETRONAS complete their three-stage development of the Dulang Oilfield offshore Terengganu in 1994. Production of natural gas also should increase to more than 65 Mm^3/d in the next 2 to 3 years because of the growing demand for natural gas by the manufacturers of LNG and nitrogen fertilizer materials in the Bintulu area of Sarawak as well as by the manufacturing and utility industries in western and southern peninsular Malaysia.

The tin industry is expected to remain depressed in 1994. Production of copper concentrate at the Mamut Mine in Sabah is expected to operate at the rate of 100,000 mt/a until 1997. Production capacity of the cement industry will expand by 2.2 Mmt/a to 9.5 Mmt/a in the next 3 years as the growing demand for cement by the construction industry continues. Malaysia should emerge as an important producer of LNG, nitrogen fertilizer materials, and petrochemical products in Southeast Asia when all of the

announced investment plans are successfully implemented in the next 3 years.

According to the Finance Ministry, Malaysia's economy is projected to grow at 7.5% in 1994. The manufacturing and construction sectors will grow at 14% and 11%, respectively, while the mining sector will grow at 1.4% in 1994-95. Malaysia's foreign debt, which stood at $25.7 billion in 1992, will continue to mount because of increased borrowing from abroad for building a new international airport and upgrading the country's major ports, Federal highways in peninsular Malaysia, and other economic development projects in various parts of the country.

[1]Where appropriate, values have been converted from Malaysia ringgits (M$) to U.S. dollars at the rate of M$2.55=US$1.00 in 1992 and M$2.57=US$1.00 in 1993.

[2]Geological Survey of Malaysia (Kuala Lumpur). Malaysia Minerals Yearbook 1990-1991. Oct. 1993, p. 3.

[3]Metal Bulletin Monthly (London). Secondary Aluminum, Malaysia's Growth Fueled by Overseas Investment. No. 279, Mar. 1994, p. 55.

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[5]Tsuruoka, D. Baptism of Fire. Far Eastern Econ. Rev. (Hong Kong), v. 157, No. 8, Feb. 24, 1994, p. 66.

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[8]Petroleum Economist (London). News in Brief, Malaysia. V. 60, No. 2, Feb. 1993, p. 47; V. 60, No. 4, Apr. 1993, p. 32; and V. 60, No. 6, June 1993, p. 79.

[9]U.S. Embassy, Kuala Lumpur, Malaysia. State Dep. Telegram 03921, May 19, 1993, p. 1.

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Wisma Selangor Dredging
142 C, Jalan Ampang
50656 Kuala Lumpur, Malaysia

Geological Survey of Malaysia
20th Floor, Tabung Haji Building
Jalan Tun Razak, P.O. Box 11110
50736 Kuala Lumpur, Malaysia

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TABLE 1
MALAYSIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
METALS							
Aluminum: Bauxite, gross weight	thousand tons	355	398	376	331	69	400
Columbium and tantalum concentrate, gross weight		—	4	—	—	—	—
Cb content of columbium[e]		—	1	—	—	—	—
Ta content of tantalum[e]		—	—	—	—	—	—
Copper, mine output, Cu content (Sabah)		23,805	24,327	25,605	28,556	25,182	25,000
Gold, mine output, Au content:							
Malaya	kilograms	678	869	871	708	873	900
Sabah	do.	1,951	1,586	1,615	2,215	2,042	2,300
Sarawak	do.	255	139	291	590	1,547	1,600
Total	do.	2,884	2,594	2,777	3,513	4,462	4,500
Iron and steel:							
Iron ore and concentrate	thousand tons	193	344	376	320	223	400
Steel, crude[e]	do.	1,125	1,200	1,200	[r]1,600	[e]1,800	2,000
Rare-earth metals: Monazite, gross weight		2,948	3,323	1,981	777	407	1,000
Silver, mine output, Ag content							
Sabah	kilograms	12,808	12,455	13,262	15,076	13,663	21,000
Sarawak[3]	do.	199	103	169	250	350	400
Total	do.	13,007	12,558	13,431	15,326	14,013	21,400
Tin:							
Mine output, Sn content		32,034	28,468	20,710	14,339	10,384	15,000
Metal, smelter		50,874	49,067	42,722	45,598	40,700	100,000

See footnotes at end of table.

TABLE 1—Continued

MALAYSIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
METALS—Continued							
Titanium: Ilmenite concentrate, gross weight		533,657	530,237	336,347	337,744	288,950	250,000
Tungsten, mine output, W content		—	—	2	3	2	—
Zirconium: Zircon concentrate, gross weight		18,704	4,279	5,579	2,608	2,184	2,500
INDUSTRIAL MINERALS							
Barite		36,526	48,291	16,600	10,525	11,551	45,000
Cement, hydraulic	thousand tons	4,794	5,881	7,451	r8,366	8,806	9,000
Clays: Kaolin		108,347	152,972	186,699	244,573	249,852	250,000
Limestone	thousand tons	r8,560	r16,465	r20,713	r22,000	e23,000	23,000
Mica		2,251	3,341	3,517	4,754	4,659	5,000
Nitrogen: N content of ammonia		278,900	228,800	286,200	331,100	333,700	350,000
Silica sand (Malaya and Sarawak)		452,025	686,604	668,244	579,491	355,389	700,000
MINERAL FUELS AND RELATED MATERIALS							
Coal	thousand tons	112	99	64	74	264	750
Gas, natural:[4]							
Gross	million cubic meters	18,683	r18,520	r21,150	r22,550	e23,500	24,000
Net[5]	do.	13,964	14,230	r16,261	r18,186	e21,200	—
Petroleum:[4]							
Crude	thousand 42-gallon barrels	214,938	227,288	238,293	240,541	e234,400	252,000
Refinery products:							
Gasoline	do.	10,979	11,854	r13,379	r13,490	e14,500	15,000
Jet fuel[e]	do.	2,766	3,000	3,000	3,000	e3,100	3,200
Kerosene	do.	4,580	6,655	r6,897	r7,097	e8,300	8,500
Distillate fuel oil	do.	15,619	17,933	e19,600	e19,000	e20,000	20,000
Residual fuel oil	do.	10,802	14,307	r13,997	r13,995	e16,000	18,000
Other[e 6]	thoousands 42-gallon barrels	9,596	12,000	12,500	e13,000	e13,000	13,000
Total[e]	do.	54,342	65,749	69,373	r69,582	e74,900	77,700

[e]Estimated. [p]Preliminary. [r]Revised.

[1]All production is from Malaya unless otherwise specified. Table includes data available through Aug. 5, 1994.

[2]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone), fertilizers, and salt is produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

[3]Byproduct from gold mines in Sarawak.

[4]Includes production from Malaya, Sabah, and Sarawak.

[5]Gross less volume of reinjected and flared.

[6]Includes LPG, naphthas, and lubricants.

TABLE 2

MALAYSIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Bauxite	Johore Mining and Stevedoring Co. Aluminium Ltd. of Canada, 30% by local investors, and 9% by other)	Bukit Raja-Pengerang, Johor	500
Cement	Associated Pan Malaysia Cement Sdn. Bhd.	Rawang, Selangor and Kantan, Perak	2,800
Do.	Cement Industries Malaysia Sdn. Bhd.	Kangar, Perlis	1,200
Do.	Kedah Cement Sdn. Bhd. (Government owned)	Langwai, Kedah	3,000
Do.	Perak-Hanjong Cement Sdn. Bhd. (60% owned by Hyundai Cement Co. Ltd. of Republic of Korea and 40% by Perak State government)	Padang Rengas, Perak	1,800
Do.	Tasek Cement Bhd.	Ipoh, Perak	1,400
Copper, concentrate	Mamut Copper Mining Sdn. Bhd. (A wholly owned subsidiary of Mega First Corp. Bhd.)	Mamut, Sabah	100
Gas:			
Natural million cubic meters per day	Esso Production Malaysia Inc.	Offshore Terengganu	22.7
Do. do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	2.8
Do. do.	Sarawak Shell Bhd.	Offshore Sarawak	38.5
Liquefied	Malaysia LNG Sdn. Bhd. (60% owned by PETRONAS, 17.5% each by Shell Gas N.V. and Mitsubishi Corp. and 5% by Sarawak State Government	Tanjung Kidurong, Bintulu, Sarawak	9,600
Petroleum, crude million 42-gallon barrels per day	Esso Production Malaysia, Inc.	Offshore Terengganu	390
Do. do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	100
Do. do.	Sarawak Shell Bhd.	Offshore Sarawak	184
Do. do.	PETRONAS Carigali Sdn. Bhd.	Offshore Terengganu	22
Tin:			
Concentrate	Malaysia Mining Corp. Bhd. (51.7% owned by Government, 9.5% by Hongkong & Shanghai Bank Nominees Pte. Ltd. of Singapore, and 38.8% by others)	Concentrate in the States of Perak and Selangor	6
Refined	Datuk Keramat Smelting Bhd. (50.5% owned by Amalgamated Metal Corp., 29% by Consolidated Tin Smelters Ltd., and 20.5% by Malaysia Mining Corp. Bhd.)	George Town, Penang	40
Do.	Malaysia Smelting Corp. Bhd. (58% owned by Straits Trading Co. and 42% by Malaysia Mining Corp. Bhd.)	Butterworth, Penang	60

TABLE 3

MALAYSIA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Bauxite		14,000
Clays[1]		25,600
Copper		e260
Gas, natural	billion cubic meters	1,926
Petroleum, crude	million 42-gallon barrels	3,700
Marble		68,000
Tin, in concentrate		1,100
Titanium		e896

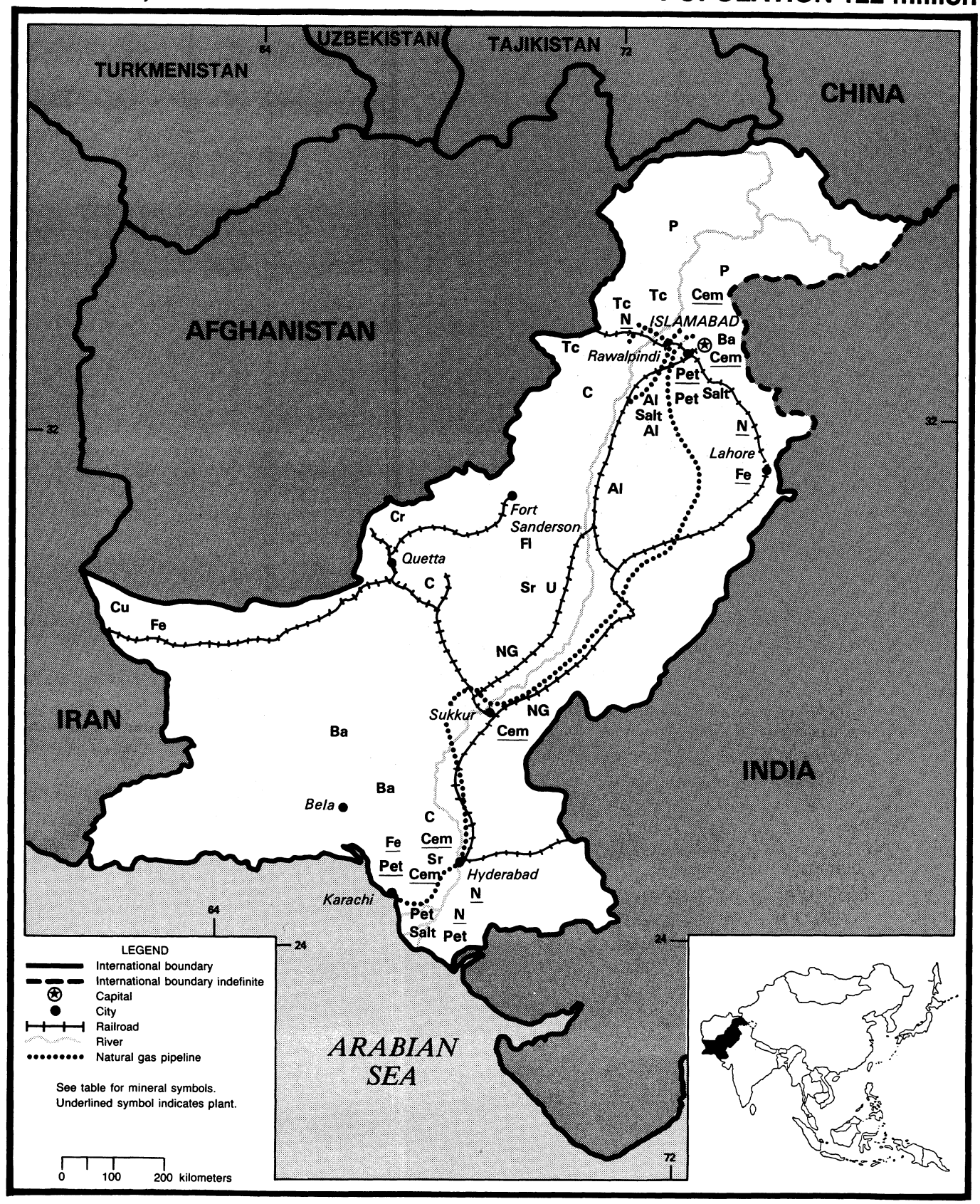
eEstimated.

[1]Includes kaolin and ball clay.

Sources: Geological Survey of Malaysia, Malaysia Mining Corp. Bhd., and PETRONAS.

PAKISTAN

AREA 803,940 km² **POPULATION 122 million**



THE MINERAL INDUSTRY OF

PAKISTAN

By Chin S. Kuo

Pakistan's growth rate of gross domestic product (GDP) fell to 3% in the fiscal year 1992-93. The agricultural sector posted a negative growth of 3.9% because of severe floods in September 1992. The manufacturing sector grew by 5.6%. The services sector showed a growth rate of 5%. Industrial output accounted for 18% of GDP. Important mineral industries were cement, fertilizers, and steel. Oil production declined slightly, while gas production was up 4.7%. Budget and trade deficits increased rapidly and combined with political uncertainty to bring the country to the brink of financial crisis in the summer of 1993.

The budget deficit stood at 8% of GDP. Debt servicing remained the largest single expenditure. Cost cutting and revenue raising measures were coupled with further investment incentives. The cost of petroleum products was raised by 10%. Almost all customs duty exemptions were removed except those on wheat, pesticides, fertilizers, and petroleum products. However, the inflation rate was estimated at 9%. Investment incentives included halving the excise duty on bank loans to 1% and extending the tax holiday on capital gains for an additional 3 years. Taxation of bonus shares also would be reduced substantially.

GOVERNMENT POLICIES AND PROGRAMS

A new, improved oil exploration and production policy was designed to speed up and simplify the processing of application for exploration licenses, as well as improve the package of incentives and the regulatory environment. All applications for exploration licenses would be decided within 60 days. All concession agreements would provide for a 5% carry for the Government during the exploration phase, with expenditure reimbursed from production over a 5-year period. The Government buyback would be limited to 20% for offshore and 35% for onshore areas. There would be no duty on exploration equipment, machinery, and materials for onshore and offshore areas. However, 5.25% would be charged on those for commercial discoveries, enhanced recovery projects, and gas compression projects.

The Government privatized Sui Southern Gas Co. as part of its deregulation program and reduced its stake in Sui Northern Gas Pipelines to 40%. British Gas Corp. was reported to be studying a possible takeover of the gas company. The Government also planned to privatize power distribution as well as thermal power generation. Water and Power Development Authority (WAPDA), the national electricity utility, was to be partially sold off.

PRODUCTION

In terms of value, the output of crude oil and natural gas represented Pakistan's largest mining activity. Coal production increased 20% to 3.3 Mmt in 1993. Mine output of metalliferous ores was small, principally bauxite and chromite. In the industrial minerals sector, the manufacture of cement and fertilizers was the dominant operation. The largest quarrying operation was stone, followed by sand and clays.

TRADE

Pakistan was to import from Kuwait 3 Mmt/a of petroleum refined products for 3 years beginning in 1993. The deal included 1.6 Mmt/a of diesel with most of the balance being fuel oil, gasoline, and kerosene. The Government devalued the rupee by 6.2% to help exporters and raised the export target to $8 billion.[1]

STRUCTURE OF THE MINERAL INDUSTRY

The Government controls the major and key components of the mineral industry, such as the steel and natural gas industries. The Government also controls outright some oilfields and is a partner in others. Privatization of state-owned enterprises, for instance, Sui Southern Gas Co., can lead to further action by the Government in the sector of power generation and distribution. However, the private mineral sector still controls a number of small operations or enterprises in cement, fertilizer, quarrying, ship-breaking, and steel.

COMMODITY REVIEW

Metals

Copper.—Resource Developmennt Corp.'s development of an integrated copper-gold metallurgical complex at Saindak, Chagai District, Balochistan Province, was underway. The $450 million project was scheduled for completion in May 1995. Funding for the project had been halved during the fiscal year of July 1993 to June 1994. The trial production date of June 1994 could be postponed. The turnkey construction contractor was China Metallurgical Construction Corp. Machinery and equipment worth $50 million against a Chinese Government credit of $84 million had arrived on-site.

The project consisted of a 12,500-mt/d open pit mine, a concentrator, and a smelter to produce 15,810 mt/a of blister copper, 1.47 mt/a of gold, and 2.76 mt/a of silver. The products were to be exported mostly to China, Japan, and Europe. In addition, the operation could produce 80,000 mt/a of pyrite and 62,000 mt/a of magnetite concentrate as byproducts. The porphyry deposit contains 412 Mmt of ore grading 0.4% copper.

Gold.—BHP of Australia (75%) and the Balochistan Development Authority (25%) agreed to begin gold exploration in an area in the Chagai District, Balochistan Province. The cost of exploration and the preparation of feasibility studies were to be borne by the former and the administrative support was to be provided by the latter. The project was estimated to cost $100 million.

Iron and Steel.—Pakistan Steel Mills planned to increase production from the current 1.1 Mmt/a to 3 Mmt/a under a 4-year, $1 billion expansion program. Effective capacity was only 78% of its 1.1-Mmt/a design capacity. The project included the installation of a third oxygen converter from a Russian plant supplier and another cold-rolling mill. The new $22.5 million converter was a 130-ton furnace. These three converters would have a target output total of 1.3 Mmt/a. A second phase of expansion would subsequently take achievable capacity to 3 Mmt/a. The overall cost of a revamping project for its existing facilities was estimated at $55.8 million. It was forecast that the country's demand for steel would rise to 3 to 4 Mmt/a from the current 1.7 Mmt/a. The company provided one-third of the country's billet requirements, dominated the hot-rolled coil market, and supplied one-half of the market's cold-rolled and galvanized products. A sum of $95 million was provided to the expansion under an agreement between the Pakistan Government and Russia. China showed a keen interest in the plan and its financing.

Pakistan Steel Mills was investigating the use of Voest-Alpine's Corex ironmaking process to revamp a sinter plant for treating imported ores and expanding its capacity from 1.5 to 1.7 Mmt/a. It fed its two blast furnaces with a mix of 67% sinter and 33% lump. Using Corex technology would open up German and Austrian credit facilities. The company hoped to import two Corex plants capable of producing 800,000 mt/a each of hot metal for the two converters. It also intended to upgrade its bloom caster, taking capacity from 275,000 to 400,000 mt/a. A secondhand tandem cold mill capable of producing 450,000 mt/a of cold-rolled coil was being acquired.

The company imported in excess of 1 Mmt/a of iron ore from Australia and India. To reduce its dependence on imported iron ore, it carried out an exploratory study of the iron ore deposits in the Kerana Hills of Punjab Province. The study showed iron ore of 63% iron content required no need for a concentrator. The iron ore deposit in Nokundi District, Balochistan Province, indicated a proven reserve of 50 Mmt of more than 50% iron content.

Industrial Minerals

Cement.—A cement shortage was experienced in northern Pakistan owing to floods creating a sudden increase in demand for rebuilding and repairing. The Government introduced measures to curb the situation by cutting import duties to $3.90/mt to encourage imports. Companies in Baluchistan Province reportedly imported about 50,000 to 60,000 tons of cement from central Asian republics through Iran.

International Finance Corp. (IFC) approved financing of $39 million for Fauji Cement Co. to construct a 1-Mmt/a, $162 million cement plant near Fatehjung in northern Pakistan. F. L. Smidth & Co. of Denmark had a $90 million contract to supply equipment for the cement plant. Construction was due for completion by the end of 1996. The domestic cement market in the region grew rapidly and the infrastructure was well developed. Smidth also was involved in two other projects: a 2,000-mt/d plant for Pioneer Cement Co. and a 3,000-mt/d plant for State Cement Corp. of Pakistan.

Extensive deposits of limestone were discovered at Pezu (300 Mmt), Lachi (60 Mmt), Nizampur (70 Mmt), and Banda Chashma in the North West Frontier Province. The Sarhad Development Authority and the Army Welfare Trust proposed to set up cement plants at Pezu and Lachi under a joint venture. Both had collaborated to set up a cement plant at Nizampur with a production capacity of 3,000 mt/d.

Fertilizer.—Fauji Fertilizer Co. and Jordanian Phosphate Mining Co. formed a joint-venture company, FFC Jordan Fertilizer Co., for the production of diammonium phosphate (DAP) at Port Qasim near Karachi. The Jordanian company holds 10% interest; Fauji, 30%; and other investors, the remaining 60%. DAP production capacity was to be 450,000 mt/a, and the total cost of the project would be $450 million. One-third of the financing would come from equity and two-thirds from loans by IFC and commercial banks. Construction was to begin in the second quarter of 1994 and production was scheduled for early 1997.

Gemstones.—Gemstones from Kashmir were auctioned in Islamabad. There were 20,500 g of Lower Kora ruby, 17,600 g of Nangimali ruby, and 15,000 g of tourmaline. These gemstones had resulted from an ongoing United Nations Development Program (UNDP) project to assist the Azad Kashmir Mineral and Industrial Development Corp. in the exploration and development of gemstones and industrial minerals.

Mineral Fuels

Coal.—Sind Province produced about 97% of the country's coal. Major coal resources are near Chhachhro in the Thar Parkar District at 9,000 Mmt; the Thatta coalfield in the Sonda District at 5,800 Mmt; the Hyderabad coalfield at 1,700

Mmt and the Badin coalfield at 1,200 Mmt, both in the Tando District; and the Lakhra coalfield in the Dadu District at 244 Mmt. Massive deposits of high-quality coal with low sulfur and ash contents and a high calorific value were found in the Thar Parkar District, and preliminary estimates put the total resource at 22,000 Mmt, more than double the initial resource. The discovery should change the fossil fuel resource situation for the country. The coal deposits were considered to have the potential to produce 50 Mmt/a of coal.

Liquefied Petroleum Gas.—Pakistan was to buy 200 mt/d of liquefied petroleum gas (LPG) from Iran. At present, the country bought 25 mt/d of LPG from Iran, transported by road. The increased imports would require the construction of storage facilities at the border and various other locations. The Government and Iran agreed to set up an oil refinery at an undecided location in Pakistan.

Natural Gas.—Mari Gas Co. started its fifth phase of development at the Mari gasfield to boost production by one-third to 11.3 Mm^3/d. The gasfield was estimated to have recoverable reserves of 178 billion m^3. The gas was to supply a new fertilizer plant set up by Fauji Fertilizer Co. and Engro Chemicals Pakistan. The Government decided to halve its interest in Mari Gas to 20% and offered its shares to the public. The country's major natural gas producer, Pakistan Petroleum Ltd., produced one-half the natural gas consumed domestically.

Petroleum.—Oil and Gas Development Corp. started production of 3,000 bbl/d and 0.71 Mm^3/d from the Sakdal oilfield and gasfield in the Margalla Hills area in June. The field boosted the company's oil production to 32,700 bbl/d and Pakistan's total to 70,000 bbl/d. Crude oil was to be trucked to the Attock refinery and gas via the Sui Northern Gas Pipelines after the installation of a dehydration plant. The country's oil consumption was estimated at 230,000 bbl/d. A hydrocracker plant was planned to be set up in Karachi by 1996 at a cost of $327,800 to process 5.6 Mmt/a of fuel oil into high-value distillate fuel products.

Pakistan Oilfields was interested in taking over from Occidental Petroleum Corp. of the United States the Pindori concession in which the Dhumal oilfield declined in its crude oil output. The company has a 5% working interest in the Dhumal oilfield. Lower output from its Meyal and Joya Mair oilfields reduced the company's crude oil production.

Reserves

The country has a broad minerals base, ranging from metallic ores, industrial minerals, to crude oil and natural gas. However, they are of insufficient quantities to be world significance, but of only local importance. Pakistan's coal reserves were estimated at 1,200 Mmt; natural gas at 650 billion m^3; and crude oil at 100 billion bbl.

INFRASTRUCTURE

Pakistan's infrastructure development cannot keep up with the demand of a fast growing population. Transportation network is inadequate and poorly developed. The Government owns a rail system of about 8,800 km, mostly broad-gauge double track. Only 286 km of the rails is electrified. The country's road system includes 40,155 km paved, 23,000 km gravel, 29,000 km improved earth, and 9,100 km unimproved earth and sand. There is a natural gas pipeline system of 2,269 km, crude oil pipelines of 250 km, and refined product lines of 885 km. Three major ports and 102 usable airfields can handle limited shipment of raw materials.

To meet the country's rising power demand, WAPDA planned to generate more electricity using coal found at Lakhra in Dadu District, Sind Province. About 5,000 MW of additional power generating capacity was to be established by the year 2000. The Lakhra Coal Development Co. was to develop a coal mining capacity of 750,000 mt/a. In addition, funding for the Hab thermal power project was to come from the World Bank at $490 million, a consortium of international banks at $700 million, and the National Development Finance Corp. the remaining $610 million. The first phase of the project would be completed by 1996. Thermal power generation accounted for more than 53% of the domestic needs.

OUTLOOK

Pakistan's mineral resources are abundant and await to be exploitated. The private sector has so far taken the form of small-scale operations in exploration, development, and production and needs to plan a strategy based on the trend of mineral utilization. The Government has to establish priorities for the exploitation of the country's mineral wealth in light of its economic growth. Mineral development also depends on foreign aid and the assistance from the UNDP.

The progress of the Saindak copper-gold project will reach a milestone in the socioeconomic development of Balochistan in the near future. With Chinese assistance, the completion of the first phase of the project is expected to be in early 1995. The project offers the potential for sufficient copper production to meet domestic needs and to provide surplus for export.

In the mineral fuels sector, the discovery of coal in Tharparkar District, Sind Province, will help generate surplus power for other Provinces and for exports. Development of new gasfields is expected to continue to ensure future energy supply in the country. More refining facilities are needed to boost production of petroleum products. It is expected that the shortfall of petroleum products will continue and still be about 3 Mmt/a in the year 2000.

[1]Where necessary, values have been converted from Pakistani rupees (R) to U.S. dollars at the rate of R30.51 = US$1.00 for 1993.

OTHER SOURCES OF INFORMATION

Agencies

Balochistan Development Authority
Quetta, Pakistan
Geological Survey of Pakistan
Quetta, Pakistan
Oil and Gas Development Corp.
Islamabad, Pakistan
Pakistan Mineral Development Corp.
Karachi, Pakistan
Pakistan Petroleum Limited
Islamabad, Pakistan
Water and Power Development Authority
Lahore, Pakistan

Publications

Federal Bureau of Statistics, Karachi:
Foreign Trade, monthly.
Pakistan Statistical Yearbook, annual.
Statistical Bulletin, monthly.

TABLE 1
PAKISTAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise sepcified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
METALS							
Aluminum: Bauxite, gross weight		1,967	2,581	4,324	3,461	4,845	14,000
Antimony ore:							
Gross weight		51	59	75	83	—	—
Sb content[e]		8	9	11	12	—	—
Chromium: Chromite:							
Gross weight		27,105	18,191	31,474	22,852	22,154	28,000
Cr content[e]		8,900	6,000	10,380	7,500	7,400	—
Iron and steel:[e]							
Pig iron	thousand tons	1,000	1,000	1,100	1,100	1,200	—
Steel, crude	do.	1,000	1,000	1,000	1,000	1,100	1,200
Lead, refined, secondary[e]		2,000	2,500	2,500	3,000	3,000	—
INDUSTRIAL MINERALS							
Abrasives, natural: Emery		1,360	54,961	10,819	298	666	—
Barite		29,718	23,329	28,751	32,432	26,336	78,000
Cement, hydraulic	thousand tons	6,936	7,488	7,762	7,793	8,321	8,000
Chalk		4,165	3,175	5,428	4,280	4,770	—
Clays:							
Bentonite		5,466	3,235	5,106	6,057	7,991	—
Fire clay		130,627	81,856	136,184	123,034	132,278	—
Fuller's earth		15,436	16,489	22,075	22,042	20,941	—
Kaolin (china clay)		39,907	61,630	44,738	37,444	37,179	—
Other		880,382	1,012,083	1,855,013	1,268,968	1,728,380	—
Feldspar		7,703	10,249	10,210	19,166	17,034	—
Fluorspar[e]		[2]4,741	[2]5,312	5,300	5,000	5,100	5,000
Gypsum, crude		466,969	477,671	521,891	462,002	534,565	—
Magnesite, crude		8,750	4,274	5,191	6,484	4,157	—
Nitrogen: N content of ammonia		[e]1,175,000	1,214,100	1,153,600	1,144,200	1,445,700	—

See footnotes at end of table.

TABLE 1—Continuted

PAKISTAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise sepcified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
Phosphate rock:							
Gross weight		e40,000	e42,000	18,985	19,828	13,822	50,000
P_2O_5 content[e]		12,800	13,000	[2]5,930	6,000	4,300	—
Pigments, mineral, natural: Ocher		2,394	1,382	1,889	5,126	6,196	—
Salt:							
Rock	thousand tons	721	763	769	853	895	1,000
Marine	do.	250	14	12	10	14	350
Total	do.	971	777	781	863	909	1,350
Sand:							
Bajri and common[e]		210,000	220,000	220,000	237,676	377,859	—
Glass		181,187	131,042	151,070	135,101	167,644	—
Sodium compounds, n.e.s.:							
Caustic soda		e60,000	e61,000	78,500	60,000	81,381	—
Soda ash, manufactured		e135,000	e135,000	147,000	146,000	186,216	—
Stone:							
Aragonite and marble		260,178	254,305	331,820	330,570	384,553	—
Dolomite		59,228	82,642	213,117	153,324	192,575	—
Limestone	thousand tons	7,897	7,810	8,432	8,759	9,074	—
Other (reported as "ordinary stone")	do.	e600	e600	46	e50	50	—
Strontium minerals: Celestite		956	1,799	1,472	1,448	1,684	2,000
Sulfur:							
Native		—	175	255	140	410	—
Byproduct, all sources[e]		25,000	25,000	26,000	26,000	27,000	—
Total[e]		25,000	25,175	26,255	26,140	27,410	—
Talc and related materials: Soapstone		38,290	30,177	33,643	23,676	46,846	60,000
MINERAL FUELS AND RELATED MATERIALS							
Coal, all grades	thousand tons	2,642	2,733	3,040	2,751	3,305	4,300
Coke[e]	do.	600	620	650	650	670	—
Gas, natural:							
Gross production	million cubic feet	e450,000	499,685	518,483	550,715	583,545	650,000
Marketed production (sales)[e]	do.	425,000	425,000	450,000	450,000	500,000	—
Natural gas liquids[e]	thousand 42-gallon barrels	75	80	80	85	85	—
Petroleum:							
Crude	do.	e16,500	19,033	23,027	22,686	21,467	25,000
Refinery products:[e]							
Gasoline	do.	7,000	7,200	7,200	7,300	7,300	—
Jet fuel	do.	4,000	4,000	4,200	4,200	4,500	—
Kerosene	do.	3,000	3,200	3,200	3,200	3,300	—
Distillate fuel oil	do.	13,000	13,200	13,500	13,600	13,600	—
Residual fuel oil	do.	12,000	12,100	12,200	12,300	12,300	—
Lubricants	do.	1,000	1,000	1,200	1,200	1,300	—
Other	do.	4,000	4,100	4,100	4,200	4,200	—
Total	do.	44,000	44,800	45,600	46,000	46,500	47,500

[e]Estimated. [p]Preliminary.

[1]Table includes data available through July 21, 1994.

[2]Reported figure.

TABLE 2

PAKISTAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(thousand metric tons unless otherwise specified)

Commodity		Major operating company	Location of main facilities	Annual capacity
Barite		Baluchistan Development Authority	Vicinity of Khuzdar, west of Sukkar	50
Do.		Bolan Mining Enterprises	do.	24
Do.		Razvi Mining Ltd.	Kalan and Retri, Abbottabad District: Kohistan District; and Gandori, Swat District	4
Bauxite		Black Mountain Minerals	Near Manshera, southwest of Rawalpindi	12
Do.		Punjab Mineral Development Corp.	Khushab, southwest of Rawalpindi	2
Cement		Associated Cement	Wah, Rawalpindi District	450
Do.		do.	Rohri, Sukkur District	270
Do.		Attock Cement (Pak) Ltd.	Hub Chowki, near Karachi	800
Do.		Gharibwhal Cement Ltd.	Jhelom, southeast of Rawalpindi	540
Do.		Javedan Cement Ltd.	16 km north of Karchi	600
Do.		Mustehkam Cement Ltd.	Hattar, Abbottabad	965
Do.		Zeal-Pak Cement Factory Ltd.	Hyderabad	1,206
Chromite		Numerous small companies	Most active mining in the Hindubagh area north of Quetta, but deposits extend 600 km along mountains on the Afghanistan border	28
Coal, bituminous		Government of Pakistan	Coalfields west and south of Rawalpindi along Salt Range and east and southeast of Quetta	[1]1,400
Do.		Pakistani Water and Power Development	Lakhra Coalfield, northwest of Hyderbad	
Fluorspar		Baluchistan Development Authority	Dilband Ridge area, Kolat District, southeast of Fort Sandeman	5
Gas, natural	million cubic feet	Sui Gas Transmission Co.	Suifield, northeast of Sukkur	225
Do.	do.	do.	Marifield, east of Sukkur	95
Petroleum:				
Crude	million barrels	Occidental Petroleum Co. Ltd.	Dhurnal Field, west of Islamabad	5.5
Do.		Oil and Gas Development Corp. (Government of Pakistan)	Tando Alam Field, east of Karachi	1.5
Do.		Union Texas	Laghari Field, southwest of Karachi	3.2
Do.	do.	do.	Kheskeli Field, southeast of Karachi	1.3
Refined	do.	Attock Refinery Ltd.	Rawalpindi	13.1
Do.	do.	National Refinery Ltd.	Karangi area of Karachi	17.4
Do.	do.	Pakistan Refinery Ltd.	Karachi	16.9
Phosphate rock		Sarhad Development Authority	Kakul mine, Hazara area north of Islamabad	50
Salt:				
Marine		Numerous small firms	Salt pans along the Arabian Sea coast near Karahi	350
Rock		Government of Pakistan	Khewra, Warcha, and Kalabagh Mines, along southern escarpment of Salt Range, Rawalpindi Division	480
Steel, crude		Karachi Rolling Mills Ltd.	Karachi	35
Do.		Newshera Engineering Co. Ltd.	Lahore	30
Do.		Pakistan Steel Mills Corp. Ltd.	Karachi	1,100
Do.		Special Steels of Pakistan	do.	35
Strontium celestite		Industrial Mineral Enterprises	Dera Ghazi Khan, southeast of Fort Sandeman	.6
Do.		Various small producers	Thano Bula Khan and Kalu Khuhar Mines, northeast of Karachi	
Talc		Black Mountain Minerals and others	In a belt extending from Parachinar near the Afghanistan border east across Peshawar Division to Sherwan	30

[1]Not yet in operation; initial planned operation capacity subject to change. Various reports suggest figures as low as 200,000 metric tons per year up to a figure of 4.3 million metric tons per year by yearend 1993.

TABLE 3

PAKISTAN: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1993

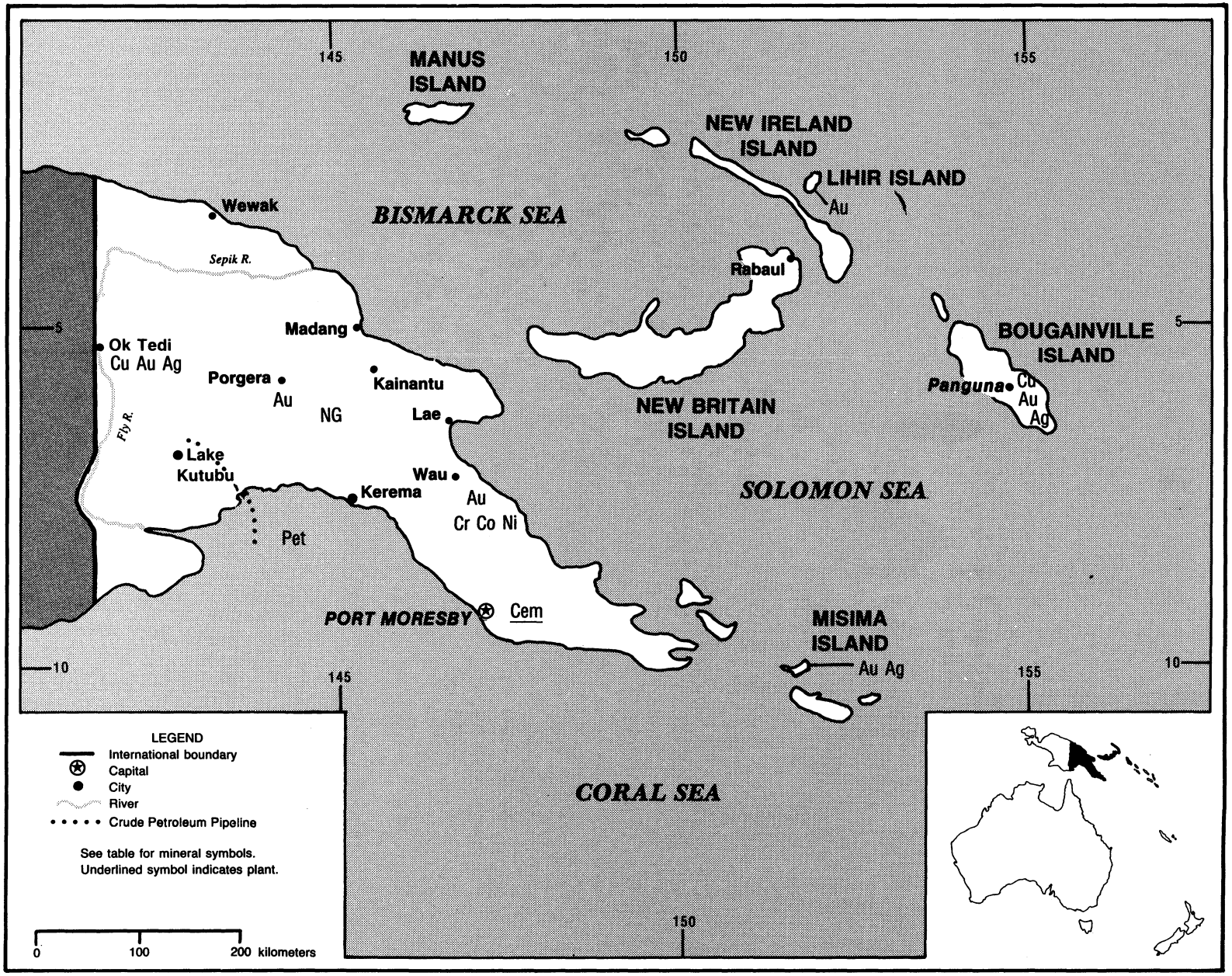
(Million metric tons unless otherwise specified)

Commodity		Reserves
Chromite		3.5
Coal, bituminous		1,200
Gas, natural	billion cubic meters	650
Petroleum, crude	billion barrels	100
Salt		1,300
Talc		NA

NA Not available.

PAPUA NEW GUINEA

AREA 461,690 km² **POPULATION 4.0 million**



THE MINERAL INDUSTRY OF

PAPUA NEW GUINEA

By Travis Q. Lyday

The mineral industry has been the cornerstone of the country's economy since 1972 when the world-class Panguna porphyry copper-gold deposit on Bougainville Island, North Solomons Province, was developed. Revenues from mining projects continued during 1993 to contribute about 30% to the Government's total revenues. Mining and petroleum accounted for 79% of the country's total exports, with petroleum comprising 31%.[1] The country's gross domestic product (GDP) rose for the second successive year, growing at a rate of 14% in 1993. The minerals sector, however, including exploration programs, mining, and the associated construction and development undertakings, expanded for a fourth consecutive year, increasing at an estimated 45% rate in 1993.

Mining consisted of large, modern, mechanized operations such as the Ok Tedi copper mine in Western Province and the Misima opencast and Porgera underground-open pit gold operations in Milne Bay and Enga Provinces, respectively, as well as panning and crude sluicing activity from individual and small-scale gold miners such as those in the Mount Kare area of Southern Highlands Province.

GOVERNMENT POLICIES AND PROGRAMS

The Government successfully renegotiated in March the acquisition of an additional 15% equity in the Porgera Mine with the three non-Government joint-venture partners, increasing its share to 25% from its previous stake of 10% acquired in 1989. The additional equity was purchased for about $141 million,[2] with each partner relinquishing a 5% interest.[3] In 1979, the Government originally took only a 5% equity share in the mine although maximum Government participation was set by negotiation with the other partners at 10% of the project. Under the terms of the Mining Act enacted in 1992, the maximum Government equity for mining projects was set at 30%, which could be purchased at cost rather than at market value.[4]

ENVIRONMENTAL ISSUES

The Government transferred in August responsibility for monitoring the environmental impact of the Ok Tedi Mine from the Department of Mining and Petroleum to the Department of Environment and Conservation. The transfer was made after charges against the mine's operator, Ok Tedi Mining Ltd. (OTML), were made by landowners' groups alleging severe, extensive, and irreparable ecological damage to the Fly, Ok Tedi, and Strickland River systems from the disposal of mine tailings downstream from the mine and that the social and cultural structures of the residents of the area were threatened by this damage.[5]

The European Commission was considering at yearend to provide funding to establish an environmental monitoring program for the country's mining endeavors. If established, the program would be headquartered in Port Moresby and administered by the Government's Department of Environment and Conservation.[6]

PRODUCTION

Three mines (Misima, Ok Tedi, and Porgera), one gas project (Hides), and one petroleum field (Kutubu) were in operation at the end of the year. These produced virtually all of the country's mineral production, excluding minor amounts of alluvial gold by individual panners, especially in the Mount Kare area, clays, sand and gravel, and stone for construction purposes. A fourth mine, the Panguna Mine on Bougainville Island, remained closed throughout the year owing to civil unrest by Bougainville Revolutionary Army militants. *(See table 1.)*

TRADE

Papua New Guinea has developed from a country dominated by subsistence agriculture and the export of the unrivaled cash crops of cocoa, coffee, and copra and palm oils in the early 1980's to one in which minerals and petroleum represent almost 80% of the country's export revenues. Papua New Guinea was the sixth largest exporter of gold in the world in 1993, primarily shipping to the Perth, Western Australia, refinery and mint.

The Porgera Mine has replaced the role of the closed Panguna Mine in the national economy and has become the nation's largest single income earner. Gold from the Porgera Mine continued to account for about 40% of all export revenues and 10% of the Government's income.

Virtually all nonfuel mineral production was exported in the form of doré, bullion, and copper-gold-silver concentrates. All petroleum production was exported from the marine export terminal in the Gulf of Papua and sold to refineries in Australia, Japan, and Southeast Asia. *(See table 2.)*

STRUCTURE OF THE MINERAL INDUSTRY

Papua New Guinea is a mineral-rich country with a modern mining industry. Mining is the only large-scale industry in the country, directly accounting for more than 30% of the GDP, estimated at $4.7 billion. In addition to several large, world-class mining operations, there are numerous small-scale mining activities. The country has a long history of mining, beginning in 1888 with the discovery of gold on what is now Misima Island, and is a world-class producer of copper and gold, ranking 13th in copper and 8th in gold in 1993. *(See table 3.)*

COMMODITY REVIEW

Metals

Copper.—Since the closure of Bougainville Copper Ltd.'s (BCL) Panguna Mine on Bougainville Island in North Solomons Province in 1989, all of the country's copper production continued to be from the Ok Tedi Mine on Mount Fubilan in the Star Mountains of Western Province, 18 km from the Indonesian Province of Irian Jaya.

The Government reported that it had regained control of most of Bougainville Island, although the Panguna Mine site had not been secured by yearend. BCL continued to assess the economic viability of resuming operations at the mine when conditions, which included the reestablishment of political stability throughout the island and confirmation in favor of restoring the mine by the Bougainville community, permitted.[7]

Ok Tedi Mining Ltd. declared *force majeure* on copper concentrate shipments from the Ok Tedi Mine during the period November 4 to December 17.[8] A prolonged drought disrupted since August barge movement between the loading port at Kiunga on the Fly River and the silo ship functioning as a storage and transshipment facility moored off Umuda Island, 850 km downstream at the river's mouth in the Gulf of Papua. However, enough concentrate was moved intermittently following localized rainstorms during the period to make up about one export cargo per month, delaying the *force majeure* declaration. Mining activity continued normally throughout the period, with concentrate being transported 160 km by slurry pipeline to the filtering and drying plant at Kiunga, where it was stockpiled until shipment could be realized. The Ok Tedi Mine supplied concentrates under long-term contract to smelters in Finland, Germany, Japan, the Philippines, and the Republic of Korea.

Pacific Minerals Pty. Ltd., a wholly owned subsidiary of Australia's CRA Ltd., continued the diamond drilling exploration program at its Wafi copper-gold prospect, Morobe Province, about 60 km southwest of the Port of Lae.

Gold.—Development of the Lihir prospect on Lihir Island, New Ireland Province, was stalled throughout the year with only limited progress being made toward acquiring a Special Mining Lease. The deposit had been on the verge of development for several years, with perceived high costs and complex technical problems initially obstructing the partners—Kennecott Explorations (Australia) Ltd. (KEA), 80%, and Niugini Mining Ltd. (NML), 20%—in the joint venture from making a go-ahead decision. In 1993, however, the amount of equity in the venture and who held it appeared to be the major cause of development deadlock.

The Government announced in April its intention to acquire a 30% equity interest in the project and almost immediately NML renewed its previous efforts for increasing its share in the project. After substantial negotiations, it was agreed in principle in September that the Government would acquire a 30% interest in the Lihir Joint Venture by paying its pro rata share of the costs incurred, NML's share would increase to 30%, and KEA's stake would decrease to 40%; each of the joint-venture partners would then vend their respective interests into a company, tentatively named Lihir Gold Ltd. (LGL), to raise the necessary additional funding to develop, construct, and eventually manage and operate the Lihir Mine.

An amended mine development proposal to that presented in March 1992 was submitted in September to the Government, reflecting the additional mining, process, and infrastructure design studies carried out in support of reducing the capital and operating costs and improving the economic return of the project. The submission proposed to process 2.825 Mmt/a of ore at an average grade of 4.37 g/mt over a 37-year period to produce about 11,300 kg/a of gold.[9] Following the successful conclusion of a development forum in November between representatives of the Lihir Joint Venture and the local, Provincial, and national Governments, the long-awaited Special Mining Lease enabling development of the project to proceed was expected to be awarded early in 1994.[10]

Production of gold for the entire year at the Porgera Mine decreased only 22% despite a 56% decline, from 36 g/mt to 16 g/mt, in the grade of ore milled. Head grades of ore milled during 1991, the first full year of production, averaged 64.5 g/mt.[11] Maintenance of output continued to be accomplished through staged expansions designed to offset declining ore grades. Stage 4A of the expansion was completed in the final quarter and included commissioning of a 75-mt/d oxygen plant, installation of a second ball mill, and the startup of a fourth autoclave that lifted processing capacity to more than 8,500 mt/d of ore.[12] A strategy for developing the next stage of the multiphased plan for optimizing the operation was expected to be completed in the first half of 1994.

Poor exploration results, continued difficulties with landowners, and legal challenges to its mining and exploration leases finally compelled CRA Minerals (PNG) Pty. Ltd., a subsidiary of CRA, to abandon completely its Mount Kare alluvial-colluvial gold prospect in Enga Province and transfer its 51% ownership of the Special Mining Lease to the minority shareholder, Kare-Puga Development Corp. (KDC), a local landowner group. Management of the reconstituted Mount Kare Project was

provided by Oakland Pty. Ltd., an equally owned subsidiary of Australia's Ramsgate Resources Ltd. and Menzies Gold NL, which was directing exploration and project development studies. There had been no mining activity since March when CRA severed its affairs at Mount Kare except for limited alluvial mining by local landowners. CRA had invested about $21 million on exploration and development at the Mount Kare site since 1987.[13]

Australia's Dome Resources NL submitted a proposal for the development of an opencut-underground gold mine at Tolukuma, about 100 km north of Port Moresby in Central Province, at yearend. Initially, about 100,000 mt/a of ore would be produced from a surface operation, producing about 1,500 kg/a of gold beginning in the latter half of 1994, with underground development beginning about 1 year later and progressively replacing the open pit operation. Initial mine life was estimated to be about 5 years.[14] Dome Resources had earlier exercised its option to acquire 100% of the prospect from Newmont Mining Co. of the United States.[15]

Gold production, in kg by mine, is shown in table 4. *(See table 4.)*

Mineral Fuels

Natural Gas.—A sixth gas turbine generator was installed at the 36-MW generating station adjacent to the Hides Gasfield in Southern Highlands Province. The facility used natural gas from the Hides wells to supply electricity to the Porgera Mine 70 km distant in Enga Province.

Exxon Inc. of the United States was planning to link with BP Petroleum in a joint venture to construct a liquefied gas plant using natural gas from the massive Hides Field.[16]

Petroleum.—The Kutubu joint-venture petroleum project in Gulf and Southern Highlands Provinces of the Papuan Basin increased its average production rate to 135,000 bbl/d, producing from 28 wells within the Agogo, Hedinia, Iagifu, and Usano Fields. Although somewhat below the targeted 140,000 bbl/d, the Kutubu project was thought to have reached in 1993 its plateau production level as originally envisioned. Production rates were expected to show a decline in 1994, although further development drilling within the current contributing fields and additional discoveries such as the Gobe Field may boost production levels again beginning in 1995.[17] The Kutubu project came on-stream in June 1992, 2 months ahead of schedule, at a cost of more than $1 billion.

With Papua New Guinea becoming an exporter of crude oil in 1992, the possibility of having a domestic refinery for supplying the necessary diesel oil, gasoline, and kerosene for the country were soon raised. The Kutubu project incorporated the country's only refinery, the small topping Iagifu Ridge Refinery 200 m above Lake Kutubu, which produced a small quantity of aviation and diesel fuels used in conjunction with the project itself.[18]

Plans for the construction of two refineries for processing crude oil from the Kutubu joint venture were approved by the Government at yearend.[16] PNG Oil Refining Co. Pty. Ltd., a subsidiary of Galveston-Houston Co. of the United States, was to build a refinery to process 20,000 bbl/d of crude at Kopi on the Kikori River in Gulf Province, near the terminus of the 266.5-km pipeline from the Kutubu Project and several hundred km from Port Moresby, while PNG Refinery Pty. Ltd., a consortium of several firms from Australia, Papua New Guinea, and the United States, planned to construct a refinery on Motukea Island in Port Moresby Harbor to process 30,000 bbl/d of crude. The refineries were slated to cost about $75 million and $160 million, respectively.[19] The Kikori refinery was to supply only the domestic market, while the Motukea refinery was to export up to 14,600 bbl/d. Papua New Guinea's consumption of oil was only about 8,500 bbl/d in 1993, most of it as diesel duel.

Reserves

Papua New Guinea, part of the largest of the islands of Oceania, also has the greatest share of Oceania's mineral resources. However, only three major nonfuel mineral commodities—copper, gold, and silver—are produced. Although there is no immediate prospect of other major commodities being produced on a large scale, subeconomic resources of chromium, cobalt, and nickel are known. Mineral sands containing magnetite and titanomagnetite occur at many locations around the coasts of Papua New Guinea. Minor quantities of platinum-group metals have been recovered from alluvial gold workings. Resources of bauxite are known on Manus Island in the Admiralty Islands and on New Ireland Island. In addition, lead, manganese, molybdenum, and zinc mineralization, as well as occurrences of industrial minerals such as limestone, phosphate guano, and phosphate rock, are widely known.

Natural gas and petroleum potential is thought to be large, but proven reserves are only now being delineated. *(See table 5.)*

INFRASTRUCTURE

Essential elements of the transportation infrastructure include 19,200 km of roads, including 640 km paved; 10,960 km gravel, crushed stone, or stabilized-soil surface; and 7,600 km unimproved earth. The length of inland waterways totals about 10,940 km and is of little importance to the transportation industry. There are 18 principal airports with permanent-surface runways out of an aggregate of 504 in the country. International shipping ports include Lae, Madang, Port Moresby, and Rabaul. There are no railroads. Electric generating capacity in 1992 was 400 MW.[20]

The vast majority of the in-place infrastructure in the country is concentrated in the Provincial capitals; therefore, the lack of infrastructure for most of the country is a distinct hinderance for the minerals industry, including exploration, mine construction and development, and transportation of

mined products.

OUTLOOK

The terrorist activity that forced the closure of the Panguna Mine in May 1989, although contained, is still present, as is proliferous urban street crime. This unrest will continue to make financiers anxious, making project financing for new projects slower to negotiate and more difficult to obtain.

However, Papua New Guinea in 1993 continued to proceed with mineral and petroleum development, such as continuing to plan for the development of the huge Lihir gold deposit, the possible construction of two oil refineries, and planning for the development of a liquefied natural gas industry to serve the Asian market.

[1]South Seas Digest (Sydney). Mining. V. 13, No. 19, Dec. 3, 1993, p. 3.

[2]Where necessary, the values have been converted from the Papua New Guinean kina (K) to U.S. dollars at the yearend rate of K0.981=US$1.00.

[3]Mining Journal. (London). Porgera Accord. V. 320, No. 8216, Mar. 19, 1993, p. 201.

[4]Pacific Island Monthly (Suva, Fiji). Now Where Did That Minerals Boom Go? V. 64, No. 3, Mar. 1994, pp. 27-29.

[5]U.S. Embassy, Port Moresby, Papua New Guinea. Department of Environment and Conservation To Monitor Ok Tedi Mine. State Dep. Telegram 02196, Sept. 14, 1993, p. 1.

[6]Mining Journal. (London). P.N.G. Environmental Monitoring. V. 321, No. 8255, Dec. 17, 1993, p. 419.

[7]South-East Asia Mining Letter (Hong Kong). Panguna Restart Under Continuing Review. V. 6, No. 4, Feb. 25, 1994, p. 4.

[8]South-East Asia Mining Letter (Hong Kong). Ok Tedi Loads Return. V. 6, No. 1, Jan. 14, 1994, p. 7.

[9]Niugini Mining Ltd. Report to the Shareholders for the Quarter Ending Sept. 30, 1993, p. 5.

[10]Mining Annual Review 1993. Papua New Guinea. Min. Journal. (London), in press.

[11]Engineering and Mining Journal. (Chicago). The Riches of Porgera. V. 194, No. 11, Nov. 1993, pp. 24-28, 31.

[12]South-East Asia Mining Letter (Hong Kong). Lower Grades Hit Porgera Output. V. 6, No. 2, Jan. 28, 1994, pp. 2-3.

[13]Pacific Island Monthly (Suva, Fiji). The Mines Are Rumbling. V. 63, No. 4, Apr. 1993, pp. 13, 15-17.

[14]Asian Journal. of Mining (Richmond North, Australia). Dome's Tolukuma Gold Backs Viability of PNG Smaller-Scale Projects. Mar. 1994, pp. X-XIV.

[15]Metal Bulletin (London). Dome Resources Makes Final Payment on PNG Gold Deposit. No. 7836, Dec. 2, 1993, p. 13.

[16]Islands Business Pacific (Suva, Fiji). Refineries Approved. V. 20, No. 1, Jan. 1994, p. 35.

[17]Oil and Gas Journal. (Tulsa, Oklahoma). Petroleum Scene Heating in Fledgling Crude Exporter Papua New Guinea. V. 92, No. 16, Apr. 18, 1994, pp. 22-26.

[18]Petroleum Gazette (Melbourne, Australia). Chevron Group's Kutubu Project Puts Papua New Guinea in the Atlas of International Petroleum Producers. V. 28, No. 2, 1993/2, pp. 7-8.

[19]South Seas Digest (Sydney). PNG Cabinet Names Oil Refiners. V. 13, No. 21, Jan. 14, 1994, p. 1.

[20]U.S. Central Intelligence Agency, Washington, DC: The World Factbook 1993, p. 304.

OTHER SOURCES OF INFORMATION

Department of Mining and Petroleum
P.O. Box 1032
Port Moresby, Papua New Guinea
Telephone: +675 212 988
Fax: +675 217 107
Department of Minerals and Energy
P.O. Box 352
Konedobu, Papua New Guinea
Telephone: +675 227 617
Fax: +675 213 701

TABLE 1
PAPUA NEW GUINEA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Copper, mine output, Cu content		204,025	170,210	204,459	193,359	203,945	250,000
Gold, mine output, Au content	kilograms	27,538	31,938	60,780	71,190	60,587	71,200
Petroleum: Crude	thousand 42-gallon barrels	—	—	—	19,400	e46,100	50,000
Silver, mine output, Ag content	kilograms	93,672	r114,543	124,880	95,498	96,094	125,000

[e]Estimated. [r]Revised.
[1]Table includes data available through July 22, 1994.
[2]In addition to the commodities listed, crude construction materials (common clays, sand and gravel, and stone) are produced, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates.

TABLE 2
PAPUA NEW GUINEA: EXPORTS OF COPPER CONCENTRATES, BY DESTINATION

(Metric tons)

Destination	1992	1993
Germany	37,507	NA
Japan	81,590	NA
Korea, Republic of	24,228	NA
Unspecified	27,891	NA
Total	171,216	[1]159,895

NA Not available.
[1]Jan. to Sept.

Source: World Metal Statistics, June 1994.

TABLE 3

PAPUA NEW GUINEA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
Copper, gold, silver	Ok Tedi Mining Ltd., operator. [BHP Minerals Holdings Pty. Ltd., managing shareholder, 60%; Mineral Resources Development Co. (State of of Papua New Guinea), 20%; and Metall Mining Corp., 20%]	Ok Tedi Mine, Mount Fubilan, Western Province	145 Cu,[1] 15 Au, 30 Ag.
Copper and gold	Bougainville Copper Ltd., operator and manager. [CRA Ltd., 53.6%; public shareholders, 27.3%; and Mineral Resources Development Co. (State of Papua New Guinea), 19.1%]	Panguna Mine, Bougainville Island, North Solomons Province[2]	180 Cu,[1] 10 Au.
Gold	Lihir Joint Venture, operator and manager. [Kennecott Explorations (Australia) Ltd., 80%; and Niugini Mining Ltd., 20%]	Lihir project, Lihir Island, New Ireland Province[3]	18.
Do.	Oakland Pty. Ltd., operator and manager. [Kare-Puga Development Corp. (local landowner group), 100%]	Mount Kare deposit, 18 kilometers southwest of Porgera, in Southern Highlands Province	4.7.
Gold and silver	Misima Mines Pty. Ltd., operator and manager. [Placer Niugini Pty. Ltd., 80%; and Mineral Resources Development Co. (State of Papua New Guinea), 20%]	Misima Mine, Misima Island, Milne Bay Province	6 Au, 100 Ag.
Do.	Placer (P.N.G.) Pty. Ltd., manager, 25%; Highlands Gold Properties Pty. Ltd., 25%; RGC (Papua New Guinea) Pty. Ltd., 25%; and Mineral Resources Development Co. (State of Papua New Guinea), 25%	Porgera Mine, 130 kilometers west of Mount Hagen, Enga Province	30 Au.
Natural gas thousand cubic meters per day	BP Petroleum Development Ltd., operator and manager, 92.5%, and Oil Search Ltd., 7.5%	Hides Gasfield, Southern Highlands Province	425.
Petroleum thousand barrels per day	Chevron Niugini Pty. Ltd., operator and manager, 19.375%; BP Petroleum Development, 19.375%; Ampol Exploration Ltd., 16.46%; BHP Petroleum (PNG) Inc., 9.69%; Oil Search Ltd., 7.76%; Merlin Pacific Petroleum Co., 4.84%; and Petroleum Resources Kutubu Pty. Ltd. (State of Papua New Guinea), 22.5%	Kutubu Oilfield, Gulf and Southern Highlands Provinces	140.
Do. thousand barrels per day	Barracuda Pty. Ltd., operator and manager, 20%. Southern Highlands Petroleum, 50%; Oil Search Ltd., 20%; Nomenco PNG Oil Co., 7%; and Mountains West Exploration Inc., 3%	South East Gobe Oilfield, Gulf Province	40.

[e]Estimated.
[1]Thousand metric tons.
[2]Closed since May 1989 because of civil unrest.
[3]Waiting for Special Mining Lease to be issued by the Government, enabling development of project to proceed. Construction expected to begin midyear 1994.

TABLE 4
PAPUA NEW GUINEA: PRODUCTION OF GOLD, BY MINE

(Kilograms)

Mine	1992	1993
Misima Mine	11,642	10,458
Ok Tedi Mine	10,494	12,331
Porgera Mine	46,191	35,976
Mount Kare Mine and other alluvial	2,863	1,822
Total	71,190	60,587

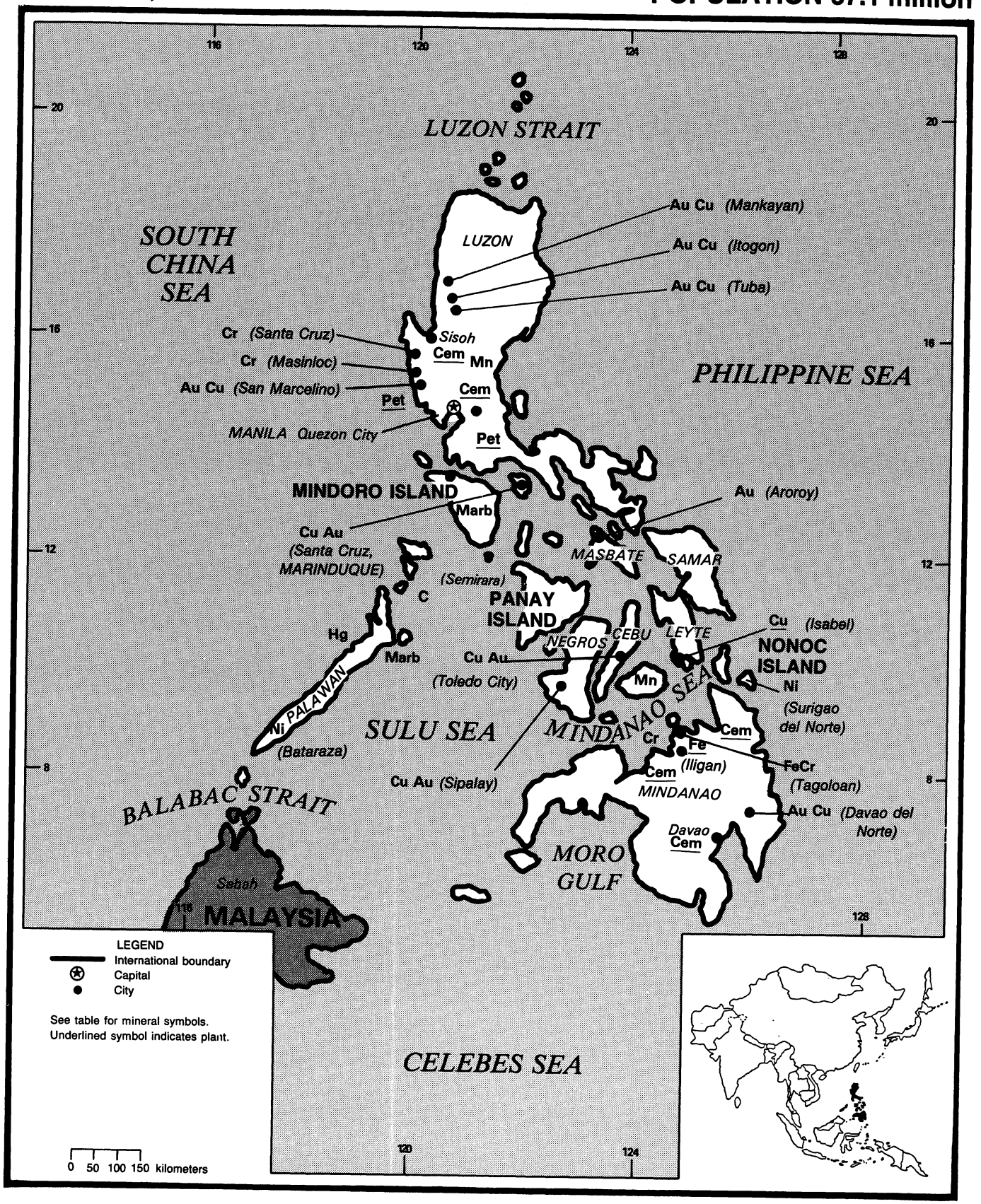
TABLE 5
PAPUA NEW GUINEA: RESERVES OF MAJOR MINERAL COMMODITIES, BY DEPOSIT, FOR 1993

Commodity, deposit, and location	Reserves[e]
Copper:	
Ok Tedi, Western Province	510 million tons ore grading 0.69% copper.
Panguna, North Solomons Province	530 million tons ore grading 0.4% copper.
Wafi, Morobe Province	19 million tons ore grading 1.4% copper.
Gold:	
Lihir, New Ireland Province	653 tons recoverable gold.
Misima, Milne Bay Province	77 tons recoverable gold.
Mount Kare, Enga Province	3 million cubic meters alluvium grading 5 grams gold per cubic meter.
Ok Tedi, Western Province	510 million tons ore grading 0.63 gram gold per ton.
Panguna, North Solomons Province	530 million tons ore grading 0.49 gram gold per ton.
Porgera, Enga Province	113 million tons ore grading 4.6 grams gold per ton.
Tolukuma, Central Province	700,000 tons ore grading 13.3 grams gold per ton.
Wafi, Morobe Province	20 million tons ore grading 1.9 grams gold per ton.
Petroleum:	
Hides Gasfield, Southern Highlands Province	6 trillion cubic meters recoverable natural gas.
Kutubu Oilfield, Southern Highlands Province	400 million barrels recoverable petroleum.
Silver:	
Misima, Milne Bay Province	1,175 tons recoverable silver.
Panguna, North Solomons Province	530 million tons ore grading 1.18 grams silver per ton.
Porgera, Enga Province	585 tons recoverable silver.
Tolukuma, Central Province	700,000 tons ore grading 37 grams silver per ton.

[e]Estimated.

PHILIPPINES

AREA 300,000 km² **POPULATION 67.1 million**



THE MINERAL INDUSTRY OF

PHILIPPINES

By Travis Q. Lyday

Agriculture is most important to the country's economy; rice, fruit, and coconuts are the major cash crops. Although the mining and quarrying sector of the minerals industry contributes only about 2% to the country's gross domestic product (GDP), this sector contributes substantially to economic development in terms of employment, exports, foreign exchange, and tax revenues.

Copper and gold production remained the backbone of the Philippine minerals industry in 1993. The country also was among the 10 largest producers of chromite in the world and remained a world force in the output of other commodities, including ferroalloys, mined nickel, and refined copper, in 1993 as well.

GOVERNMENT POLICIES AND PROGRAMS

Laws to implement the much-needed mining code again were still waiting passage by the Philippine Congress at yearend, although the House of Representatives unanimously passed in December its version of a bill commonly referred to as the Philippine Mining Act of 1993. This bill would codify all existing mining laws except the Small Scale Mining Act and would provide systems for the exploration, development, use, and conservation of mineral resources, as well as grant incentives to boost the mining industry. It would also provide for safety and pollution control, which have been major concerns of the environmental aspects of mining.

The House also approved two complementary bills aimed at aiding the mining industry as well as bolstering the Mining Act. The first would cut the excise tax on metallic and nonmetallic minerals from 5% and 3% of gross revenue, respectively, to a uniform rate of 1% for 6 years, and 2% thereafter; the second bill would exempt structures and improvements used for impounding, treating, neutralizing, filtering, or cleaning mine and/or industrial wastes and tailings from real property taxes.[1] The Philippine Senate was expected to pass early in 1994 its own mining and mining-related (tax) bills, with the full Congress enacting a comprehensive mining code into law by yearend 1994.

A ruling by the Bureau of Internal Revenue required the Central Bank to stop buying the country's domestic gold bullion production. Until this determination, all primary and byproduct gold recovered domestically had to be sold to the Central Bank, with the exception of the gold contained in copper concentrates that subsequently were exported to Japan. (Additionally, some gold production from small-scale miners frequently bypassed official Central Bank purchasing stations.)

At yearend, the Government-owned National Development Corp. (NDC) was in various stages of selling to private interests several mineral industry companies under the auspices of the Asset Privatization Trust (APT), including the following: National Steel Corp. (NSC), the country's leading manufacturer and supplier of steel products; Petron Corp., owned by the Philippine National Oil Co. (PNOC) and the largest oil refining and marketing company in the country with about 40% of the local petroleum market; Philippine Associated Smelting and Refining Corp. (PASAR), the country's only copper smelter-refinery; Philippine Phosphate Fertilizer Corp., the largest phosphatic fertilizer plant in Asia; and Semirara Coal Corp. (SCC), the country's largest coal mining company.

ENVIRONMENTAL ISSUES

The Department of Environment and Natural Resources (DENR) was the primary Government agency responsible for conservation, management, development, and proper use of the country's natural resources, including its minerals. Since its reorganization in 1987, the DENR continually strives to maintain a balance between proper economic objectives and protection of the environment within the mining industry through appropriate regulation.

However, Philippine policies and standards of regulating the condition of the environment are mostly derived from the Industrialized West, or First World, and sometimes are based on premises more stringent than are warranted or feasible for the Philippines, a less developed country. Accompanying legislation to the Mining Act of 1993 was passed by the House of Representatives, which would exempt from taxation pollution abatement structures, such as tailings dams, and improvements in treating and/or neutralizing mine waste.

PRODUCTION

The minerals industry of the Philippines employed an estimated 420,000 people, including almost 300,000 engaged in small-scale mining and panning activities, chiefly in artisanal gold workings. Over the years, the metallic sector has consistently accounted for 75% of the industry's production value and nearly 100% of export earnings. Of the more than 20 mining companies producing metallic minerals in the country, 4 were mining primary gold and 7 were involved in production of copper concentrates. Several of the copper miners also produced gold and

silver as byproducts. Other companies produced other metals, including chromite, manganese, nickel ore, and zinc concentrates. The industrial minerals sector was dominated by the production of limestone for the manufacture of cement, marble, and sand and gravel for construction uses.

Refined gold and copper remained the country's most important mineral products, each representing more than 30% of total mineral value. *(See table 1.)*

TRADE

Japan remained the primary market for the country's mineral products in 1993. Almost all of the Philippine production of chromite and nickel and more than 60% of its copper concentrates were exported to Japan. The remaining copper concentrates were smelted by PASAR into copper cathodes at Isabel, Leyte Province, for export, again primarily to Japan.

As a result of generally weak global demand, the value of most major mineral commodity exports declined from that of 1992. Gold recorded the largest decline, decreasing more than 60% from $128 million[2] in 1992 to $51 million in 1993. Copper exports fell almost 22%, from about $140 million to about $109 million. Silver exports decreased more than 16%, from about $2 million to less than $1.7 million.[3]

Mining contributed less than about 7% to the Philippines' total export earnings.[4]

STRUCTURE OF THE MINERAL INDUSTRY

The Philippines has one of the oldest and most active mining industries of Southeast Asia. It has a strong, established mining structure. Mining in the Philippines operated on a leasehold system until 1987, when this system was abolished in favor of a new system of joint-venture or production-sharing agreements under policies governed by interim regulations until a new mining law and enabling regulations could be passed. It is expected that a new mining code will promote the involvement of foreign investors in large-scale exploration, development, and utilization of mineral resources while retaining small-scale development by Filipinos. State control over mineral resources will provide the flexibility to undertake mining as a Government activity or to enter into coproduction, joint-venture, or production-sharing agreements with the domestic private sector or with corporations and associations whose capital is owned 60% by Filipinos, as required by the 1987 Constitution.

The mining industry of the Philippines was dominated by a few large-scale private local companies mining chromite, copper, and gold. Coal was mined by numerous private companies and three subsidiaries of the state-owned PNOC. One of the large Government-owned companies produced more than one-half of the country's coal. Copper, ferroalloys, and phosphate fertilizer were produced by three joint-venture firms. Cement was produced by at least 18 private companies. Most were Filipino owned, with only minor foreign interests. *(See table 2.)*

COMMODITY REVIEW

Metals

Chromium.—Chromite production is centered in the Province of Zambales in northern Luzon. Metallurgical- and refractory-grade chromite have been produced from two principal deposits mined by Acoje Mining Co. Inc. and Benguet Corp., respectively. Production in 1993 was dominated by Benguet from its Masinloc operations (Coto Mine), based on the world's largest single refractory chromite deposit. Historically, the principal supplier of metallurgical chromite has been Acoje from its Santa Cruz operations, but the mine remained dormant during both 1992 and 1993. Additionally, small-scale operations in the vicinity provided feed ore to the major producers' plants. There also has been significant output of metallurgical- and chemical-grade chromite from alluvial and lateritic deposits on eastern Samar Island, Samar Province, and on Dinagat Island, Surigao del Norte Province.

A $2.8 million 60-40 joint-venture agreement between the Government and China was approved for the exploration, development, extraction, and processing of chromite deposits in Surigao del Sur Province, northeastern Mindanao. The agreement authorized Mauban Mining and Development Corp. to establish a mine of 43,200-mt/a chromite ore capacity and a plant of 18,000-mt/a chromite concentrate capacity.[5]

Portman Mining Ltd. of Australia announced at yearend that it was selling its chromite tenements at Mount Metalisbong, Luzon Island, and the adjacent 500,000-mt/a chromite mill and beneficiation plant at Acoje to Phoenix Resources Inc. for $2.2 million. In addition, Phoenix was to repay $3 million in loans advanced by Portman in support of Phoenix's Philippine operations.[6]

Copper.—Six producers continued to supply most of the country's copper output in 1993: Atlas Consolidated Mining and Development Corp.'s Carmen open pit-underground and Lutopan underground mines in the Toledo district of central Cebu; Benguet's Dizon Mine, Lepanto Consolidated Mining Co. Inc.'s Mankayan (Lepanto) Mine, and Philex Mining Corp.'s Sto. Tomas II (Padcal) Mine, all in Benguet Province, northern Luzon; Marcopper Mining Corp.'s San Antonio Mine on the Island of Marinduque; and Maricalum Mining Corp.'s Sipalay Mine in Negros Oriental Province on Negros Island. North Davao Mining Corp.'s Amacan Mine in Davao del Norte Province, Mindanao, was closed in 1992.

To avoid continued dependence on toll smelting in foreign countries, the Philippine copper industry, in conjunction with the Government and Japanese investors, formed PASAR and brought into operation in 1983 the country's only copper smelter-refinery at the Leyte Industrial Development Authority site at Isabel, Leyte Province, in central Philippines. The expansion and modernization program completed in

1992 resulted in the PASAR plant becoming the fourth largest in the Asia-Pacific region. In addition to taking feed from Philippine mines, the plant also imported and toll smelted about 60% of its throughput concentrate requirements from overseas.

Atlas temporarily suspended operations December 26 at its Carmen Mine after a tropical cyclone flooded and severely damaged equipment and facilities at the underground mine. Dewatering and repair work were expected to resume early in 1994. Production was not affected, however, at either the Carmen open pit or the concentrator.[7]

Ferroalloys.—A severe drought continued to adversely affect the Philippine ferroalloy industry centered on the island of Mindanao. Acute daily power outages, precipitated by low water levels in Lake Lanao, which drives the Agus-1 hydroelectric powerplant operated by National Power Corp. (NPC), caused the plants to shut down for extended periods throughout the year. The affected plants, including Christina Chemical, Ferrochrome Philippines Inc., Integrated Chrome Corp., Mindanao Ferro-Alloy Corp., Metro Alloy, and Philippine Mineral Alloy Corp., also were confronting a future of permanent output reduction or even closure because of a 40% price increase in electrical power rates proposed by NPC. The increase was to be implemented early in 1994.[8]

Gold.—The principal gold-producing districts of the Philippines are Baguio, northern Luzon; Masara, southeastern Mindanao; Masbate Island; Paracale, southern Luzon; and Surigao, northeastern Mindanao. Primary gold production in 1993 was dominated by two companies, Atlas Consolidated and Benguet, which between them accounted for more than one-half of the officially recorded Philippine primary production. In addition, small-scale mining operations, primarily in Mindanao, produced an unknown amount of gold and secondary gold was produced, mainly as a byproduct from copper mining.

Philex Mining approved in midyear development of its Bulawan underground mine in Negros Occidental Province, Negros Island. Modest mining during the first 2 years was expected to be concentrated on higher grade ore treated in a carbon-in-leach (CIL) plant, with an expansion of mining occurring thereafter, with processing converted from CIL to flotation-cyanidation.[9]

Benguet suspended early in the year its Paracale Gold Operations in Camarines Norte Province, Luzon Island, and in an attempt to improve its cash-flow and resolve its heavy debt burden, Atlas Consolidated curtailed toward yearend its Masbate Gold Operations in Masbate Province, Masbate Island.

Iron and Steel.—The Philippines does not have a fully integrated steel sector, although several rod and bar mills and galvanizing plants have been established, all since the end of World War II.

Steelmaking in the Philippines presently involves scrap-based electric furnace steel melting operations, of which there were 17 facilities in 1993—13 in the National Capital Region; 3 in Pampanga Province to the northwest of Manila, the capital; and NSC's plant at Iligan. NSC is the single largest steel company in the country, producing about one-third of total production. Power outages due to drought continued to interrupt the Philippine steel melting industry in 1993.

The Philippine Sinter Corp., owned by Kawasaki Steel Corp. of Japan, imports iron fines from various overseas sources, primarily Australia, and exports iron ore sinter and pellets to Japan. The plant was opened in 1977 and has a capacity of 5 Mmt/a.

Following a favorable Supreme Court ruling announced in February concerning NSC's dispute with the former owner of the Iligan steelworks, the Government's NDC, under the auspices of the APT, recommenced its efforts to privatize the Iligan steel plant. At yearend, plans were made to offer a 65% stake to "strategic" investors, who would help in the management of the company, and to offer to "local" investors the remaining 35% interest in the plant. The privatization was scheduled to be concluded by April 1994.[10]

Manganese.—Manganese output was centered on the islands of Bohol, Busuanga, Marinduque, Masbate, and Siquijor, as well as in the Provinces of Zamboanga del Sur and Agusan del Norte on Mindanao. Many of the deposits, however, are small and unsuitable for large-scale mining operations.

Portman Mining announced in the third quarter the termination of its efforts to develop a small manganese mine at its property on Bohol Island. Metallurgical testing of the 350,000-ton manganese resource indicated difficulty in beneficiating the 23% manganese ore to a marketable standard.[11]

Nickel.—The mainstay of Philippine nickel production continued to be Rio Tuba Nickel Mining Corp.'s Rio Tuba Mine in the far south of Palawan Island, Palawan Province. Hinatuan Mining Corp. and Taganito Mining Corp. both operated smaller mines in Surigao del Norte Province. All three worked lateritic nickel deposits, exporting all ore production to Japan.

Philnico Mining and Industrial Corp.'s lateritic nickel mine on Nonoc Island in Surigao del Norte Province, off the coast of northeastern Mindanao, and its associated refinery on nearby Marinduque Island remained mothballed throughout 1993. However, Philnico reportedly still was planning a rehabilitation program for mining the ore and producing refined nickel and nickel-cobalt sulfides.[12] Until the closure in 1986 of this nickel mine-refinery complex, the Philippines was the world's fifth largest producer of nickel.

Mineral Fuels

Coal.—Philippine coal production was dominated by SCC and PNOC, both of which were Government-owned companies, producing almost 70% of the country's output. SCC operated the Unong open pit on the island of Semirara in Antique Province, while PNOC worked three underground mines in

Cebu, eastern Mindanao, and at Malangas in western Mindanao. The remainder of production came from 30 to 35 small-scale private producers operating near-surface mines.

Much of the coal mined in the Philippines is low grade and is often blended with higher grade imported coals. Cement production remained the leading consumer, closely followed by power generation. All of SCC's production was used to fuel coal-fired powerplants of the NPC, although the company was considering supplying coal to the cement industry. The high moisture content of SCC's production may, however, make its coal uncompetitive.

Petroleum.—Only about 2% of the country's crude petroleum requirements was produced domestically in 1993, with the countries of the Middle East, dominated by Saudi Arabia, continuing to supply more than 80% of total crude imports.

Pilipinas Shell Petroleum Corp. began construction of new process units with capacity of 110,000 bbl/d adjacent to its existing oil refinery at Tabangao in Batangas Province, 120 km south of Manila. After startup of the $667 million refinery, planned for third quarter 1994, the old refinery will be decommissioned. The new refinery will produce a wider range of products than the previous refinery and be more energy and process efficient.[13]

The Government accepted in December a bid of $502 million by the Saudi Arabian Oil Co. to purchase 40% of Petron Corp., the largest oil refiner and marketer in the country. Petron was owned by the Government's PNOC and operated the 155,000-bbl/d Bataan Refinery in Bataan Province, Luzon Island, and a network of about 860 service stations. PNOC planned to retain 40% of Petron and sell the remaining 20% to public investors through the stock market in early 1994.[14]

Reserves

Mineralization in the Philippines, although usually not rich, nonetheless is extensive. The Chamber of Mines of the Philippines ranks the mineral reserves of the country at the top in Southeast Asia and seventh worldwide. There are abundant deposits of gold, especially in eastern Mindanao and in Benguet and Camarines Norte Provinces, Luzon Island; copper in Zambales Province on Luzon and in the Visayan Islands; zinc at Zamboanga on Mindanao; high-grade chromium in Zambales and Camarines Sur Provinces on Luzon, near Surigao on Mindanao, and near Puerto Princesa on Palawan Island; and nickel in Surigao del Norte Province, especially on Hinatuan and Nonoc Islands, Mindanao. Ores of iron, manganese, and mercury also occur in the country. Lead and silver, as well as less common cadmium and molybdenum, mineralization occurs in association with other ores. Deposits of industrial minerals include limestone on Cebu, Luzon, and Romblon Islands; salt and asbestos on Luzon; marble on Romblon and Panay Islands; gypsum on Luzon; sulfur on Luzon, Leyte, and Mindanao Islands; and phosphate rock on Cebu and Bohol Islands. Asphalt occurs on Leyte, and coal deposits are found on Cebu and Mindoro Islands. *(See table 3.)*

INFRASTRUCTURE

Sea and air transport are essential elements of the communications-transportation infrastructure of the Philippines, an archipelago of more than 7,100 islands comprising about 300,000 km^2 of land area. Railroads (378 km in length, all on Luzon) and pipelines (357 km for refined oil products) play only a modest role, but there is more than 157,000 km of roads, including 22,400 km paved, 85,050 km loose-surface improved (gravel, crushed stone, or stabilized soil surface), and 50,000 km unimproved earth. Inland waterways, of which there is 3,219 km, are relatively unimportant because of their shallowness. None can accommodate vessels with a draft greater than 1.5 m.

There are 238 usable airports in the country, 73 with permanent-surface runways, and most are on the larger islands such as Luzon and Mindanao. Two, those at Cebu and Manila, are international airports. Many of the smaller islands can only be reached by interisland ferries or small chartered vessels.

International shipping uses 18 major ports, including Bacolod (Negros Occidental Province), Bago (Negros Occidental Province), Batangas (Batangas Province), Cagayan de Oro (Misamis Oriental Province), Cebu (Cebu Province), Davao (Davao del Sur Province), Dumaguete (Negros Oriental Province), General Santos (South Cotabato Province), Iligan (Lanao del Norte Province), Iloilo (Iloilo Province), Legaspi (Albay Province), Manila (National Capital Region), Ozamis (Misamis Occidental Province), Puerto Princesa (Palawan Province), Subic Bay (Zambales Province), Surigao (Surigao del Norte Province), Toledo (Cebu Province), and Zamboanga (Zamboanga del Sur Province), out of more than 450 seaports in the country. The merchant marine fleet included 38 petroleum, oils, and lubricant tankers; 1 chemical tanker; 1 liquefied gas tanker; and 1 combination ore-oil tanker.

The Philippines has a considerable excess of power-generating capacity relative to present actual production levels, but power costs are relatively high. Generating capacity in 1992 was reportedly 7.85 GW. The Philippines was the world's second largest producer, after the United States, of geothermal energy. Total power production in the same year was 28 billion KW • h.[15]

Generally, the infrastructure for mineral industry operations is regarded as adequate on the Islands of Cebu, Luzon, Marinduque, Negros, and Palawan. Elsewhere, infrastructural development is less than ideal.

OUTLOOK

The Philippine mining industry in 1993 was neither vibrant nor healthy, reflecting a general decline that began in the mid-1980's. The primary contribution to this situation continued to be the fact that the mining regime contained in the 1987

Philippine Constitution, which basically provided for a production-sharing structure to replace the leasehold system with the Government, has not been realized yet with enactment of an implementing mining code; thus, new investment into the industry continued to be hindered.

The mining industry also continued to be hampered by the country's tax structure, which was one of the highest in the world. The combination of all the direct and indirect taxes applied to the mining industry continued to place a tremendous burden on the individual companies, making them uncompetitive with respect to other producers, as well as continuing to discourage new investment, both domestic and foreign.

Although the Philippine mining industry has been damaged by recent slowdowns of economic activity in the industrialized countries, poor international commodity prices, and severe natural disasters such as volcanic activity, drought, and tropical cyclones, which drastically affected its competence in the international marketplace, it can become a competitive, functional, vibrant industry again with prompt passage of a new mining code that encompasses a more affordable tax structure.

[1]Chamber of Mines of the Philippines. CMP Newsletter. V. 1, No. 2, Nov.-Dec. 1993, p. 1.

[2]Where necessary, values have been converted from the Philippine peso (P) to U.S. dollars at the yearend rate of P24.6=US$1.00.

[3]Mining Annual Review 1994. The Philippines. Min. J. (London), in press.

[4]Chamber of Mines of the Philippines. CMP Newsletter. V. 1, No. 1, Sept.-Oct. 1993, p. 9.

[5]Mining Journal (London). V. 321, No. 8251, Nov. 19, 1993, p. 346.

[6]South-East Asia Mining Letter (Hong Kong). V. 6, No. 1, Jan. 14, 1994, p. 2.

[7]———. V. 6, No. 3, Feb. 11, 1994, p. 7.

[8]Metal Bulletin (London). No. 7823, Oct. 18, 1993, p. 10.

[9]Work cited in footnote 3.

[10]Metal Bulletin (London). No. 7843, Dec. 31, 1993, p. 16.

[11]South-East Asia Mining Letter (Hong Kong). V. 5, No. 18, Sept. 24, 1993, p. 5.

[12]Metal Bulletin (London). No. 7748, Jan. 18, 1993, p. 8.

[13]South-East Asia Mining Letter (Hong Kong). V. 5, No. 13, July 16, 1993, p. 3.

[14]———. V. 5, No. 24, Dec. 22, 1993, p. 8.

[15]U.S. Central Intelligence Agency. The World Factbook 1993, pp. 310-311, Washington, DC.

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Agencies

Department of Environment and Natural Resources
DENR Building
Visayas Avenue, Diliman
Quezon City, Metro Manila
Philippines
Telephone: +63 2 976 626
Fax: +63 2 994 938

Mines and Geo-Sciences Bureau
Department of Environment and Natural Resources
North Avenue, Diliman
Quezon City, Metro Manila
Philippines
Telephone: +63 2 998 642
Fax: +63 2 951 635

Philippine Institute of Mining, Metallurgy and Geology
c/o Lands Geology Division
Mines and Geo-Sciences Bureau
North Avenue, Diliman
Quezon City, Metro Manila
Philippines
Telephone: +63 2 998 544
Fax: +63 2 951 635

Association of Concrete and Asphalt Producers of the Philippines
c/o Consolidated Aggregates of the Philippines
28 Quirino Highway
Quezon City, Metro Manila
Philippines
Telephone: +63 2 361 0008
Fax: +63 2 362 4575

Chamber of Mines of the Philippines
504 Valgosons Reality Building
2151 Pasong Tamo
Makati, Metro Manila
Philippines
Telephone: +63 2 817 7996 and 817 0443
Fax: +63 2 817 6869

Chamber of Small Scale Mining Industry of the Philippines
37 Forestry Street, VASRA Village
Diliman, Quezon City
Philippines
Telephone: +63 2 963 094
Fax: +63 2 442 3353

Ferro Alloy Producers' Association of the Philippines
2d Floor, Salamin Building
Salcedo Street, Legaspi Village
Makati, Metro Manila
Philippines
Telephone: +63 2 866 971 and 866 974
Fax: +63 2 816 6412

Marble Association of the Philippines
c/o Teresa Marble Corp.
117 Shaw Boulevard, Pasig
Metro Manila
Philippines
Telephone: +63 2 673 6849
Fax: +63 2 673 6849

Miners Association of the Philippines, Inc.
Suite 527, Don Santiago Building
1344 Taft Avenue
Ermita, Manila
Philippines
Telephone: +63 2 590 720
Fax: +63 2 586 456

Philippine Cement Manufacturer's Association
Philippine Cement Center Building
4 EDSA, corner Connecticut Street
Greenhills, San Juan
Metro Manila
Philippines
Telephone: +63 2 597 078 and 819 1325
Fax: +63 2 810 6940

Philippine Chamber of Coal Mines
426 Comfoods Building
Chino Roces and Senator Gil J Puyat Avenues
Makati, Metro Manila 1200
Philippines
Telephone: +63 2 886 312
Fax: +63 2 886 307

Philippine Chamber of Commerce and Industry
ODC International Plaza Building
219 Salcedo Street-7th Floor
Legaspi Village
Makati, Metro Manila 2801
Philippines
Telephone: +63 2 817 6981
Fax: +63 2 816 1946

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Mines and Geo-Sciences Bureau, Manila: Mineral News Service and Annual Report.

TABLE 1

PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
METALS						
Arsenic: White (equivalent of arsenic acid)	4,652	5,092	e5,000	e5,000	2,000	5,000
Chromium: Chromite, gross weight:						
Metallurgical-grade	105,153	61,792	r89,208	r51,708	50,000	123,000
Chemical-grade	18,424	20,240	r19,756	r12,465	15,000	21,000
Refractory-grade	92,985	r100,920	r82,520	r37,517	40,000	135,000
Total	216,562	r182,952	r191,484	r101,690	105,000	279,000
Copper:						
Mine output, Cu content	r193,077	r182,318	r148,347	r123,523	3136,257	235,000
Metal:						
Smelter	r156,268	r153,462	r167,462	r168,831	3170,502	168,900
Refined	r132,193	125,938	r115,471	r145,674	172,000	172,000
Gold, mine output, Au content kilograms	r30,040	24,591	r25,916	r22,702	315,826	35,000
Iron and steel:[e]						
Ferroalloys, electric furnace:						
Ferrochromium	82,000	56,000	323,730	e27,400	12,000	82,000
Ferromanganese	—	—	5,000	e5,000	5,000	5,000
Ferrosilicon	9,000	10,000	10,000	e10,000	10,000	20,000
Steel, crude thousand tons	300	300	250	e250	250	300
Lead: Metal, secondary refined	13,600	12,100	17,500	16,800	17,000	17,500
Manganese ore and concentrate, gross weight	3,002	14,583	r4,064	3,224	3,500	14,500
Nickel: Mine output, Ni content	15,380	15,818	13,658	r14,000	r10,200	28,000
Silver, mine output, Ag content kilograms	50,630	47,110	38,414	31,100	32,466	52,500
Zinc, mine output, Zn content	1,200	53	—	—	—	2,000
INDUSTRIAL MINERALS						
Barite[e]	3348	r 3289	500	500	500	500
Cement, hydraulic thousand tons	3,624	6,360	r6,913	r6,734	6,500	6,900
Clays:						
Bentonite	5,961	r14,607	r42,066	31,896	30,000	42,000
Red	r22	r148	552	e500	3791	550
White	r18,172	r104,953	51,528	e45,000	45,000	105,000
Other	e500,000	e500,000	r808,133	r742,074	700,000	810,000
Feldspar	36,803	r168,368	47,979	e45,000	324,233	168,500
Gypsum and anhydrite:						
Natural	2,000	r30,000	r28,000	r25,000	25,000	30,000
Synthetic[e]	115,000	115,000	—	—	—	115,000
Lime	e4,000	12,470	7,458	e10,000	10,000	51,000
Magnesite	4,796	r3,675	e700	e700	700	4,800
Perlite	e1,100	3,150	2,894	e2,800	2,800	3,650
Phosphate:						
Guano	48,347	r5,820	11,689	e10,000	35,250	48,500
Phosphate rock	4,139	r13,263	20,633	e20,000	20,000	20,650
Pyrite and pyrrhotite (including cuprous), gross weight	359,155	429,604	359,607	e350,000	350,000	430,000
Salt, marine	488,674	490,407	492,859	r495,816	3535,481	785,500

See footnotes at end of table.

TABLE 1—Continued

PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Sand and gravel:							
Silica sand	thousand tons	185	r256	r532	500	3500	535
Other[4]	thousand cubic meters	15,140	15,673	15,677	r15,787	15,000	15,800
Stone:							
Dolomite		r486,607	r320,529	608,779	600,000	3691,763	609,000
Limestone[5]	thousand tons	3,831	3,837	r5,384	r5,092	35,190	5,400
Marble (dimension), unfinished	cubic meters	e5,000	6,391	r24,178	r19,667	20,000	24,000
Volcanic cinder[e]	do.	2,000	2,000	2,000	2,000	2,000	7,000
Tuff		r54	r99,911	51,756	e50,000	33,264	100,000
Quartz		r56,077	r35,975	e60,000	e50,000	50,000	94,000
Crushed, broken, other[e 6]	thousand cubic meters	1,000	1,000	1,000	1,000	1,000	1,000
Sulfur:[e]							
S content of pyrite		r147,000	r158,000	r155,000	r64,000	114,000	195,000
Byproduct of metallurgy		134,000	120,000	119,000	111,000	147,000	150,000
MINERAL FUELS AND RELATED MATERIALS							
Coal, all grades		1,334,676	1,186,531	1,267,102	1,510,000	31,531,487	1,500,000
Petroleum:							
Crude	thousand 42-gallon barrels	1,876	1,727	1,091	r2,945	33,321	3,900
Refinery products:							
Liquefied petroleum gas	do.	e2,500	2,920	2,777	r2,914	32,607	XX
Gasoline	do.	e12,600	14,261	15,321	r13,378	313,052	XX
Jet fuel	do.	4,420	3,421	e3,400	r4,067	33,058	XX
Kerosene	do.	3,415	3,897	3,299	r4,280	34,270	XX
Distillate fuel oil	do.	20,806	23,729	24,157	r26,733	325,213	XX
Residual fuel oil	do.	22,160	26,428	24,131	r27,474	328,431	XX
Other[e]	do.	5,282	35,647	5,500	r 33,922	35,886	XX
Refinery fuel and losses	do.	3,052	3,071	2,839	r3,300	33,300	XX
Total	do.	e74,235	83,374	81,424	r86,068	385,817	3101,634

[e]Estimated. [r]Revised. XX Not applicable.

[1]Table includes data available through July 1, 1994.

[2]In addition to the commodities listed, the Philippines produces platinum-group metals as byproducts of other metals, but output is not reported quantitatively, and no basis is available to make reliable estimates.

[3]Reported figure.

[4]Includes "pebbles" and "soil" not further described.

[5]Excludes limestone for road construction.

[6]Includes materials described as rock, crushed or broken; stones, cobbles, and boulders; rock aggregates; and broken adobe.

TABLE 2

PHILIPPINES: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies	Location of main facilities	Annual capacity[e]
Cement		Davao Union Cement Corp., 100%	Davao City plant, Mindanao Island	648
Do.		Floro Cement Corp., 100%	Higait plant, Mindanao Island	450
Do.		Iligan Cement Corp., 100%	Iligan City plant, Mindanao Island	420
Do.		Northern Cement Co. Inc., 100%	Sison plant, Luzon Island	640
Do.		Republic Cement Corp., 100%	Norzagaray plant, Luzon Island	950
Do.		Rizal Cement Co. Inc., 100%	Binangonan plant, Luzon Island	964
Chromite:				
Concentrate		Acoje Mining Co. Inc., operator. (Voest Alpine AG of Austria, 75.6%; and Merlin Mining NL of Australia, 24.4%)	Santa Cruz Mine, Zambales Province, Luzon Island	[1]100
Do.		Alamag Processing Corp., operator. (Pacific Shore Mining Co., 50%; and Rio Chico Mining Corp., 50%)	Llorente, Eastern Samar Province, Samar Island	[2]20
Do.		Benguet Corp., 70%, operator; and Consolidated Mines Inc., 30%	Masinloc Chromite Operations, Zambales Province, Luzon Island	[3]105
Ferrochromium		Ferrochrome Philippines Inc., operator. (Voest Alpine AG of Austria, 100%)	Tagoloan plant, Lanao del Norte, Mindanao Island	60
Do.		Ferro-Chemicals Inc., 100%	Manticao plant, Misamis Oriental Province, Mindanao Island	30
Do.		Integrated Chrome Corp., 100%	Cagayan de Oro plant, Misamis Oriental Province, Mindanao Island	26
Coal		Semirara Coal Corp. (Government), manager. (Voest Alpine AG of Austria, 60%; National Development Corp., 56%; and Development Bank of the Philippines, 4%)	Unong Mine, Antique Province, Semirara Island	1,000
Copper, ore		Atlas Consolidated Mining and Development Corp., 100%	Cebu Copper Operations, Cebu Province, Cebu Island	24,250
Do.		Benguet Corp., 50%, operator; and Dizon Copper-Silver Mines Inc., 50%	Dizon Copper-Gold Operation, Zambales Province, Luzon Island	6,000
Do.		Far Southeast Resources Inc., manager. (Lepanto Consolidated Mining Co. Inc., 60%; and CRA Ltd. of Australia, 40%)	Far South East Project, Benguet Province, Luzon Island	[4]4,000
Do.		Lepanto Consolidated Mining Co. Inc., 100%	Mankayan Mine, Benguet Province, Luzon Island	1,100
Do.		Marcopper Mining Corp., 60%; and Placer Dome Inc. of Canada, 40%	San Antonio Mine, Marinduque Province, Marinduque Island	30,000
Do.		Maricalum Mining Corp., manager. [Asset Privatization Trust (Government), 100%]	Sipalay Mine, Negros Occidental Province, Negros Island	6,250
Do.		Philex Mining Corp., 100%	Sto. Tomas II (Padcal) Mine, Benguet Province, Luzon Island	10,200
Copper, metal, refined		Philippine Associated Smelting and Refining Corp., operator. [National Development Corp. (Government), 42%; Japanese consortium of companies led by Marubeni Corp., 32%; domestic copper producers led by Atlas Consolidated Mining and Development Corp., 21%; and International Finance Corp. (United Nations agency), 5%]	Isabel, Leyte Province, Leyte Island	172
Gold:	kilograms	Atlas Consolidated Mining and Development Corp., 100%	Masbate Gold Operations, Masbate Province, Masbate Island	[5]2,500
Do.	do.	Benguet Corp., 100%	Benguet Gold Operations, Benguet Province, Luzon Island	[5]1,100

See footnotes at end of table.

TABLE 2—Continued

PHILIPPINES: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies	Location of main facilities	Annual capacity[e]
Gold—Continued:	kilograms	Benguet Corp., 100%	Benguet Antamok Gold Operation, Benguet Province, Luzon Island	3,000
Do	do.	Philex Mining, 100%	Bulawan Mine, Negros Occidental Province, Negros Island	[4]2,800
Do	do.	United Paragon Mining Corp., operator. (Paragon Resources of Australia, 12.5%; and public shares, 87.5%)	Longos Mine, Camarines Norte Province, Luzon Island	1,800
Iron ore, sinter		Philippine Sinter Corp., operator. (Kawasaki Steel Corp. of Japan, 100%)	Cagayan de Oro, Misamis Oriental Province, Mindanao Island	[6]5,000
Nickel, ore		Rio Tuba Nickel Mining Corp., operator and 60%; and Japanese interests, 40%	Rio Tuba Mine, Palawan Province, Palawan Island	500
Do.		Hinatuan Mining Corp., 100%	do.	100
Petroleum:	thousand barrels per day	Caltex (Philippines) Inc., 100%	Caltex Batangas Refinery, Batangas Province, Luzon Island	68
Do.	do.	Petron Corp., operator. [Philippine National Oil Co. (Government), 100%]	Petron Bataan Refinery, Bataan Province, Luzon Island	156
Do.	do.	Pilipinas Shell Petroleum Corp., 100%	Shell Batangas Refinery, Batangas Province, Luzon Island	70
Steel		National Steel Corp., operator. [National Development Corp. (Government), 100%]	Iligan, Lanao del Norte, Mindanao Island	350

[e]Estimated.
[1]Metallurgical-grade concentrates.
[2]Chemical-grade concentrates.
[3]Refractory-grade concentrates.
[4]In planning stage during year.
[5]On care and maintenance during year.
[6]Self-fluxing sinter.

TABLE 3
PHILIPPINES: RESERVES OF MAJOR MINERAL COMMODITIESFOR 1993

(Thousand metric tons)

Commodity	Reserves[e]
METALS	
Chromite:	
Chemical	3,226
Metallurgical	10,962
Refractory	4,709
Copper, primary	3,690,681
Gold, primary	82,782
Iron ore:	
Aluminous laterite	292,010
Lump ore	70,732
Magnetite sand	103,610
Lead, primary	6,313
Manganese	1,287
Mercury	16,243
Molybdenum	30,608
Nickeliferous laterite/garnierite	1,480,154
Zinc, primary	6,163
INDUSTRIAL MINERALS	
Asbestos	24,498
Barite	163
Bauxite	82,650
Clays	1,126,965
Bentonite	1,385
Diatomaceous earth	3,903
Dolomitic limestone	486,430
Feldspar	29,380
Guano	1,014
Gypsum	1,883
Limestone:	
Agricultural	312,949
Industrial	9,556,168
Magnesite	26,534
Marble	4,058,472
Perlite	18,509
Phosphate rock	2,407
Pumice and pumicite	21,878
Pyrite	983,402
Silica pebbles/cobbles/boulders	6,804
Silica rock form	1,750,561
Silica sand	213,873
Sulfur	44,011
Talc	503

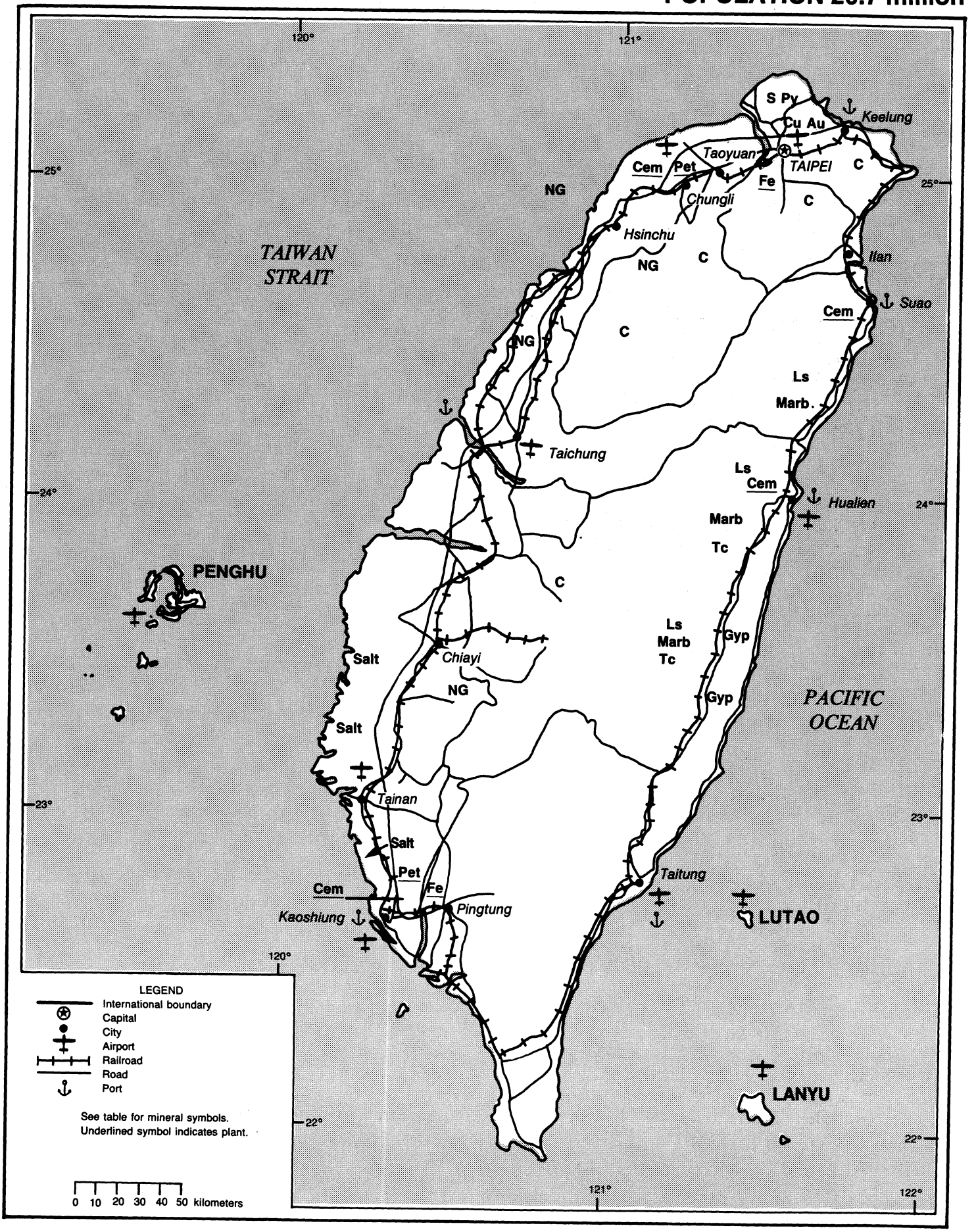
[e]Estimated.

Source: Mines and Geosciences Bureau.

TAIWAN

AREA 35,980 km²

POPULATION 20.7 million



THE MINERAL INDUSTRY OF

TAIWAN

By Pui-Kwan Tse

The pace of the world economy recovery was slower than expected in 1993. It caused Taiwan's industrial growth rate to slip from 6.1% in 1992 to 6.0% in 1993, 1% below the Taiwan authorities projected rate. The under performance of the economy growth rate in the past 3 years forced the Taiwan authorities to slow plans to rebuild and extend the island's industrial and social infrastructure. Facing shortage of predicted revenue and an increase of public debt levels, the Taiwan authorities reduced about 22% of the projected spending on the 6-year plan. Projects were reduced from the original 779 to 634. In July 1993, the Taiwan authorities announced an economic stimulus package, including low-cost loans to small businesses, tax exemption for certain hi-tech industries, and release of Government land to private enterprises to promote private investment in the public sector and to expand hi-tech industry. The authorities hoped that these changes would shift away from reliance on public spending to sustain industrial growth levels in the 1990's. Private consumption was a key role in sustaining Taiwan's economy growth during the past 2 years.

Business Environment Risk Intelligence S.A. of the United States ranked Taiwan as the second best place behind Switzerland for investment. To provide a better investment environment, the Taiwan authorities built an industrial development zone in the western part of island. The zone is located on the reclaimed land in the western part of Yunlin County. The zone was expected to house oil refinery, petrochemical, power, and steel plants. The Taiwan authorities hoped that the zone would resolve the problem of land shortages and high land prices. Factories in urban areas were encouraged to move to the zone to avoid antipollution protests from local residents.

Taiwan's population grew from 20.7 million in 1992 to 20.9 million in 1993, and per capita gross national products (GNP) increased from $10,196 in 1992 to $10,382[1] in 1993. The total labor force increased to 8.7 million, and the unemployment rate remained low at 1.45%. The output value of the mining sector was 0.4% of GNP, which is insignificant compared with other sectors.

The consumer price index rose only 2.94% in 1993 from that of 1992, a 5-year low. Retail prices on agricultural and industrial raw materials remained stable in 1993. The resident and office rental housing prices increased moderatedly but they were offset by the decline of international oil prices.

GOVERNMENT POLICIES AND PROGRAMS

The Taiwan authorities decided to open Taiwan's financial securities sector to more foreign firms. The market liberation will bring the local market into alignment with the policies of the General Agree on Tariffs and Trade (GATT). The Government thought that the growing competition would improve domestic financial management and upgrade the operational technology of local securities houses.

The Government developed a set of programs to attack major problems in the areas of land, environment, labor, tariff rates, and financing to improve domestic investment conditions. The Government urged the local business community to "keep their roots in Taiwan" and to stop exodus. The plan indicated that those who make large, substantial investments will be given the opportunity to arrange for favorable financing through the issuance of corporate convertible bonds. Imports of essential raw materials and equipment will be given preferential tariffs or quota rates. The Environment Protection Agency (EPA) will develop more flexible regulations for less polluted industry.

Taiwan's Legislative Yuan passed a revised copyright law in April 1993. The law strengthened the protection of foreign patents and copyrights in a bid to avert U.S. trade sanctions after the United States placed Taiwan on a "priority watch list" of countries failing to prevent piracy of U.S. copyrights. The new law gave explicit legal protection to a wide range of products.

The Ministry of Economic Affairs (MOEA) planned to pursue a southern economic investment strategy. MOEA believed that the Asian Pacific region will have the world's highest economic growth in the next two decades. MOEA wanted to build Taiwan as a future multinational hi-tech operations regional center in the Asian Pacific region. Taiwan has signed investment guarantee agreements with Indonesia, Malaysia, the Philippines, Singapore, and Vietnam. Negotiation for such an agreement with other southern countries was proceeding.

Taiwan's EPA was established in August 1987 under the Executive Yuan. Environmental degradation became one of the most serious problems in Taiwan. According to Taiwan's Six-Year Development Plan, the country will invest $37 billion in pollution control and environmental protection system. Environmental regulations will be strengthened to protect the society. In 1992, Taiwan's Legislative Yuan passed the Air Pollution Control Act and strengthened noise pollution regulations to enforce a higher living standard in the

country.

PRODUCTION

Industry production accounts for about 34% of the country's GNP. The Industrial Development Bureau (IDB) of the MOEA is the major Government agency to deal with industry affairs. IDB initiates specific industrial policies and development strategies. However, overall economic planning, coordination, and policy evaluation are handled by the Council for Economic Planning and Development.

As natural gas and coal reserves have been increasingly depleted, the mining industry has suffered negative growth in the past two decades. Total mining output was less than 1% of total industrial production. The major mining activities in Taiwan are coal, dolomite, limestone, marble, natural gas, and salt. Coal, natural gas, and salt are mined in the western part of the country. Marble and limestone are operated in the eastern part of the country. Employment in the mining and quarrying industry has steadily decreased since the early 1980's to 17,300 in 1993. The production of major mineral commodities is listed in table 1.

TRADE

Due to the demand for both consumer and capital goods and the sluggish world economy, the total trade amounted only to $162.02 billion in 1993, up 5.6% over that of 1992. Exports for the year reached $84.92 billion, an increase of 4.3% over that of the previous year. Imports rose by 7.0% to $77.08 billion. The United States, Japan, and Hong Kong remained Taiwan's largest trading partners, accounting for 24.8%, 19.9%, and 12.5% of the country's total trade, respectively.

Due to a shortage of labor, Taiwan's industry shifted from labor-intensive products to technology- and capital-intensive goods. In 1993, the imports on metals, minerals, and machinery equipment accounted for more than 35% of the total imports. It reflected the demand for quality consumer goods and capital- and technology-intensive machineries and equipment.

STRUCTURE OF THE MINERAL INDUSTRY

The demand for mineral products has continuously increased over the years but local supplies keep dwindling. The bulk of domestic supply can meet only about 25% of the country's needs. Coal, oil, and natural gas are the country's most valued mine products. Carbonate minerals, such as dolomite, limestone, and marble, comprised the most important nonfuel mining sector. In addition to the aggregates, clays, feldspar, salt, and talc make up the remaining mine production. In the metals production sector, the country produces iron and steel and processes aluminum, copper, lead, nickel, tin, and zinc from imported raw materials. Major nonfuel and fuel producers are listed in table 2.

COMMODITY REVIEW

Metals

Copper.—Since the shutdown of the island's only smelter-refinery in 1991, Taiwan relied on imports for refined copper. Because of rising labor costs, difficulties in land acquisition, and stiffening environmental protection regulations, domestic copper companies were exploring opportunities to move their less profitable wiremaking plant to neighboring countries. Demand for electrolytical copper and related copper products remained stable in 1993. In 1993, Taiwan produced 485,189 tons of bare copper wire and 246,856 tons of power wire and cable. Taiwan's Directorate General of Telecommunications and Taipower accounted for more than 50% of total domestic cable demand.

Iron and Steel.—China Steel Corp. (CSC) was operating at its full capacity, 5.65 Mmt of steel, in the past several years and still could not meet its domestic demand. In fiscal year 1993, CSC began to implement its fourth phase expansion project. Construction for the expansion plant was expected to take 4 years. After completion, CSC's annual total crude steel capacity will be 8 Mmt. The expansion plan included a blast furnace, two oxygen converters, and a hot strip mill. Davy International of the United Kingdom was awarded the contract to provide the new furnace to CSC. The new blast furnace has an output capacity of 7,000 mt/d and was scheduled to be blown in late 1996.

MOEA planned to sell up to 1.5 billion CSC shares to private investors in Taiwan as part of privatization of state-owned enterprises. Currently, the Government holds about 76% of CSC shares and has made an effort to reduce its stake to 51% in 1994.

In 1993, Yeih Loong Group (YLG) planned to invest $3.8 billion during the next 5 years to build an integrated steel mill. According to the plan, the mill will have an annual output capacity of 6.5 Mmt of crude steel in Chiku, Tainan County. However, the Government suggested that YLG consider building the steel mill in either the Yunlin Sandbank Basic Industry Park or the Auku Industrial Park in the east-central of the island. YLG would finance about one-third of the project with its own funds and the remainder of funds through Government low-cost loans.

Tung Ho Steel Enterprise commenced its $400 million H-beam plant at Miaoli, Taichung County, in July 1993. The plant has an annual output capacity of 645,000 tons of H-beam by using direct current arc furnace technology. Tung Ho has a total output capacity of 1.2 Mmt from its Kaoshiung, Miaoli, and Taoyuan plants. The enterprise planned to upgrade both Kaoshiung and Taoyuan plants to direct current arc furnace and to expand the total output capacity to 2 Mmt by the year 1995.

Nickel.—Taiwan Nickel Refining Corp. (TNRC), owned partially by Inco Europe and Korea Nickel Corp., planned to expand its annual output capacity from 12,000 tons to 24,000 tons to meet domestic demand. TNRC supplied 100%

of Tang Eng Iron Work's nickel needs for its stainless steel plant. Tang Eng expected to increase its stainless steel output capacity to 300,000 tons in 1994. Currently, Taiwan consumed about 20,000 mt/a of nickel.

Industrial Minerals

Cement.—Taiwan's cement industry will face a cement crunch in 1997 when the mining rights on its east coast are expired. Domestic cement production would be cut as much as 40% in 1997. Cement companies are looking for investment opportunities in other countries to construct greenfield plants to ensure the stable supply of cement for the country's needs. MOEA approved Chia Hsin Cement Corp. to invest $120 million to build a new cement plant in the Philippines. Construction of the new plant would be started in the second half of 1994.

Titanium.—Du Pont Taiwan, a subsidiary of E.I. du Pont de Nemours and Co. Inc. of the United States, delayed the opening of its titanium dioxide pigment plant in Taiwan. The current overcapacity in the titanium pigment industry was cited as the reason for the delay. Commissioning was postponed from October 1993 to March 1994.

Mineral Fuels

The Government approved Chinese Petroleum Corp. (CPC) and other state-owned companies to form joint ventures with Chinese companies to explore in the East China Sea (Dong Hai). The Government also allowed local private companies to build refineries, import crude oil, and sell refined products in Taiwan. CPC planned to form a joint venture with a local private company to build a 200,000-bbl/d naphtha cracker plant.

Taiwan's coal production dropped to 328,124 tons. This decline can be attributed to the Government policies designed to close unsafe operations, high production costs, and reduced domestic coal resources. Since 1985, MOEA implemented a policy to close mines that failed to meet safety and profitability standards. The number of operating mines in Taiwan has steadily decreased from 108 pits in 1985 to 22 pit at the end of 1992.

In 1993, Taiwan imported 24.9 Mmt of coal, mainly from Australia, the Republic of South Africa, Indonesia, the United States, and China, in descending order. Taipower was the largest consumer of coal in Taiwan, accounting for more than 50% in 1993. CSC was the second largest coal consumer. Taipower was trying to reduce its dependence on high-price, long-term contract coal. The Government encouraged companies such as Taipower to explore joint-venture exploration of energy resources in Australia and Indonesia.

Currently, Indonesia is a sole source for supplying liquefied natural gas (LNG) to Taiwan. CPC, which is responsible for LNG imports, wanted to diversify its sources of supply. CPC signed a contract with Petronas of Malaysia to supply 2.2 Mmt of LNG yearly beginning in 1995. CPC also signed a letter of intent to buy 2 Mmt of LNG from Qatar's Ras Laffan plant. CPC joined with Total of France to build a $1.2 billion refinery plant in Vietnam.

Reserves

Taiwan has a very weak mineral resource base, and output is limited to mostly carbonate minerals, small amounts of other industrial minerals, and neligible amounts of fossil fuels, the overall value of which is significant only to the local economy. Reserves of major minerals are listed in table 3.

INFRASTRUCTURE

The railroad system comprises 4,600 km of common carrier lines and 3,525 km of industrial carrier lines of 1.075-m-gauge and 1,075 km of 1.067-m-gauge. Common carrier lines are owned by the Government and operated by the Railway Administration under the Ministry of Communications. Industrial carrier lines are owned and operated by Government enterprises. Taiwan has a total of 20,041 km of highway, including 17,095 km of bituminous or concrete pavement, 2,371 km of crushed stone or gravel, and 575 km of graded earth.

Taiwan has four international harbors—Keelung, Kaoshiung, Hualien, and Taitung. Suao harbor on the northeastern coast is used as a supplementary port to Keelung. There are two international airports—Chiang Kai-shek International Airport in Taoyuan and Hsiaokang International Airport in Kaoshiung. In addition, there are a number of domestic airports on the east and west coasts of the island.

OUTLOOK

Because Taiwan lacks a strong and varied minerals resource base, the domestic mining sector will never contribute significantly to the output of downstream manufacturing. Rising wages and a strong international currency exchange rate have affected export competitiveness and have forced domestic businesses to establish operations in lower cost neighboring countries such as China, Indonesia, Malaysia, Thailand, and Vietnam. The future for Taiwan-based industry seems to lie in high-technology-intensive manufacturing.

[1]Where necessary, values have been converted from New Taiwan dollars (NT$) to U.S. dollars at the rate of NT$26.4=US$1.0 in 1993.

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Agencies

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Taipei, Taiwan

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2 Chenkiang Street
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TABLE 1
TAIWAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
METALS							
Copper: Metal, refined		43,237	16,090	—	—	—	—
Gold, primary	kilograms	269	72	—	—	—	—
Iron and steel: Metal:							
Pig iron	thousand tons	5,780	5,474	5,561	5,292	6,116	7,000
Ferroalloys:							
Ferromanganese		30,623	43,631	40,110	37,802	13,628	50,000
Ferrosilicomanganese		25,510	20,587	12,801	3,991	—	30,000
Ferrosilicon		19,277	15,501	6,252	2,606	689	20,000
Steel, crude	thousand tons	9,047	9,747	10,957	10,705	12,038	13,000
Nickel, refined[e]		r10,000	r10,400	r11,200	r10,000	9,000	14,000
Silver, primary	kilograms	6,491	3,926	—	—	—	—
INDUSTRIAL MINERALS							
Cement, hydraulic	thousand tons	18,043	18,459	19,389	21,464	23,971	24,000
Clays:							
Fire clay		85,803	99,389	79,497	55,008	35,094	80,000
Kaolin		98,115	105,084	92,970	e100,000	100,000	150,000
Feldspar		9,806	7,321	1,339	2,216	2,102	5,000
Gypsum: Precipitated		3,904	1,743	3,723	r1,673	3,182	3,000
Lime		615,047	553,517	613,942	r669,712	650,000	750,000
Mica		4,290	4,946	8,596	r11,038	9,751	13,000
Nitrogen: N content of ammonia		202,916	216,306	243,389	223,719	219,781	250,000
Salt, marine		169,982	82,820	195,319	25,732	176,298	250,000
Sodium compounds, n.e.s.:							
Caustic soda		86,100	110,600	119,600	131,223	140,978	180,000
Soda ash		115,572	e120,000	109,320	r91,497	e100,000	150,000
Stone:							
Dolomite	thousand tons	419	339	363	254	281	400
Limestone	do.	14,069	13,924	15,352	16,885	13,085	15,000
Marble	do.	12,231	11,349	11,352	14,604	17,713	20,000
Serpentine	do.	469	388	414	405	433	500
Sulfur		76,060	95,533	125,819	118,621	153,076	180,000
Talc		22,559	22,123	18,518	r6,085	5,015	15,000

See footnotes at end of table.

TABLE 1—CONTINUED

TAIWAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
MINERAL FUELS AND RELATED MATERIALS							
Carbon black		57,632	62,230	60,330	65,409	62,527	75,000
Coal, bituminous	thousand tons	784	473	403	335	328	400
Coke	do.	88	70	14	r—	—	20
Gas, natural:							
Gross[e]	million cubic meters	1,158	1,129	776	630	573	700
Marketed[e]	do.	1,094	1,100	700	580	500	650
Petroleum:							
Crude	thousand 42-gallon barrels	850	1,148	694	r400	400	600
Refinery products:							—
Gasoline	do.	27,084	32,610	37,070	40,740	44,050	—
Kerosene	thousand 42-gallon barrels	2,032	e2,200	r2,350	e2,000	e2,000	—
Diesel oil	do.	27,015	29,260	30,240	r30,800	33,840	—
Fuel oil	do.	71,207	76,470	83,580	81,870	84,820	—
Lubricants fuel oil	do.	1,038	e1,000	e1,000	e1,000	e1,000	—
Asphalt	do.	2,901	e3,000	e3,000	e3,000	e3,000	—
Liquefied petroleum gas	do.	14,170	14,480	14,220	14,880	15,010	—
Other[2]	do.	9,060	9,080	8,740	8,120	7,990	—
Total[e]	do.	154,507	168,100	r180,200	182,410	191,710	222,000

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Includes data available through May 25, 1994.

[2]Inclues naphtha, solvent oil, and base oil.

TABLE 2

TAIWAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	Asia Cement Corp.	Hsinchu	1,800
Do.	do.	Hualien	11,150
Do.	Chia Hsin Cement Corp.	Kaoshiung	2,200
Do.	Lucky Cement Corp.	Tungao	1,800
Do.	Chien Tai Cement Co. Ltd.	Kaoshiung	1,758
Do.	Hsing Tai Cement Co. Ltd.	Taipei	1,300
Do.	Taiwan Cement Corp.	Chutung	1,400
Do.	do.	Hualien	280
Do.	do.	Kaoshiung	1,900
Do.	do.	Suao	2,230
Do.	Universal Cement Corp.	Kaoshiung	1,400
Coal, bituminous	Numerous independent operators	Taipei Prefecture (22 pits)	400
Marble	Taiwan Marble Co., Ltd.	Panchiao	10
Nickel	Taiwan Nickel Refinery	Kaoshiung	12
Petroleum:			
Crude thousand barrels per year	Chinese Petroleum Corp.	Chuhuangkeng and Tungtzuchiao	850
Refinery products do.	do.	Kaoshiung	150,000
Do. do.	do.	Taoyuan	33,000

TABLE 2
TAIWAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Steel	China Steel Corp.	Kaoshiung	6,400
Do.	Tung Eng Iron Work Co. Ltd.	do.	90
Sulfur	China Petrochemical	Taipei	50

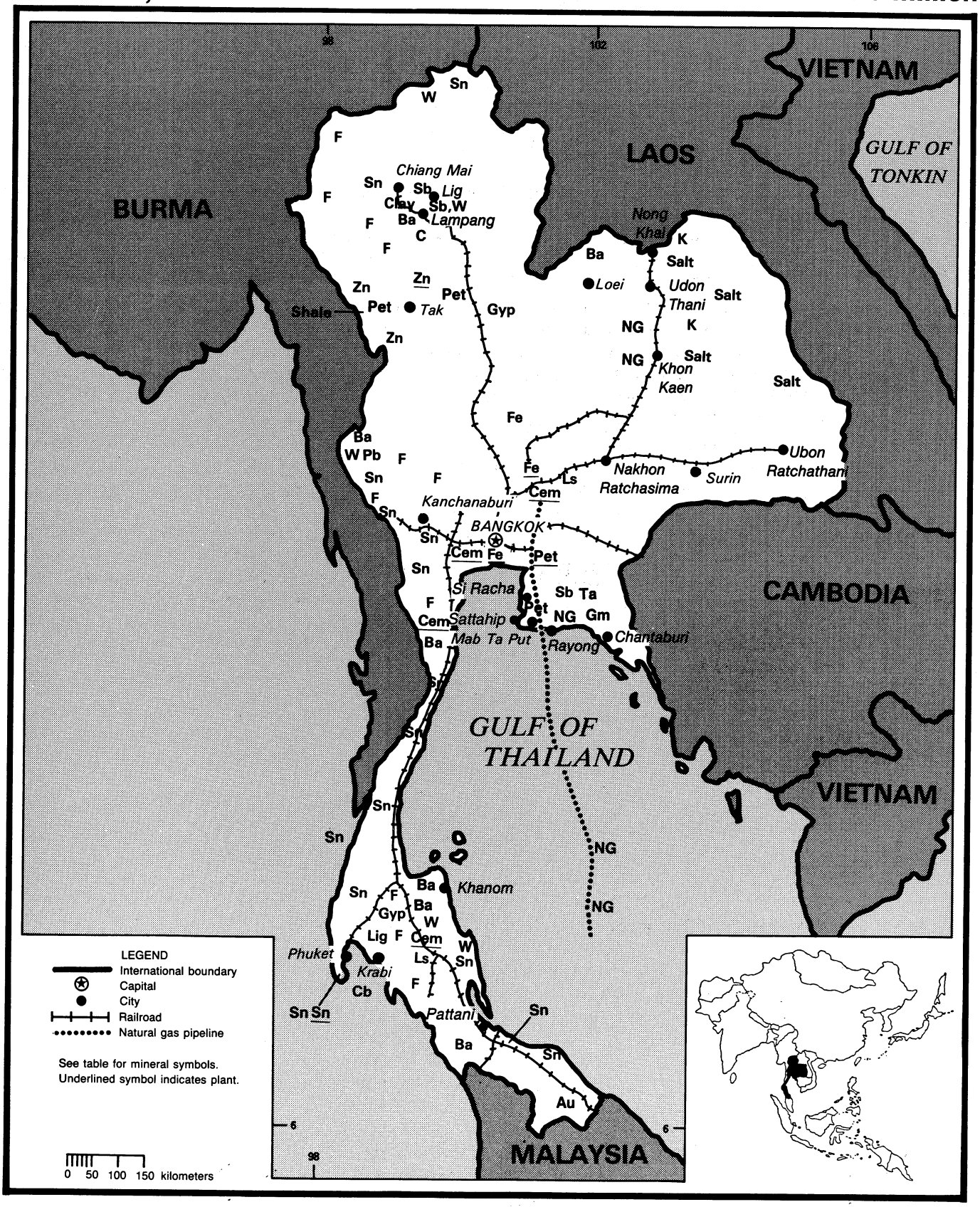
TABLE 3
TAIWAN: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Reserves
Coal	170,000
Dolomite	110,000
Limestone	395,000
Marble	280,000,000
Natural gas thousand cubic meters	20,000,000
Talc	2,000

THAILAND

AREA 514,000 km² **POPULATION 58.0 million**



THE MINERAL INDUSTRY OF

THAILAND

By Pui-Kwan Tse

The global economy continued its recession in 1993. The Thai economy maintained its strong growth in 1993. The gross domestic products (GDP) recorded a healthy expansion of 7.5% from a year before. The total GDP reached $123.3[1] billion, resulting in a per capita income of $2,115. The consumer price index rose just 3.2% in 1993, the lowest increase since 1987. However, some Thai economists worried that all warning signs of inflation were there: rising labor wages, falling interest rates, and a huge surplus of cash in the financial system.

The Thai economy has undergone a considerable change during the past two decades. The agriculture sector employed more than two-thirds of the labor force and produced more than one-quarter of the GDP in the late 1970's. In 1993, the agriculture sector accounted for only 12% of GDP but the labor force made up more than 60% of the Thai work force. Agricultural production grew by only 1.7% in 1993 over that of previous year. Farm incomes were estimated to have fallen by 12% because of falling prices in 1993. The rapid investment from both Thai and foreign investors, manufacturing, wholesale and retail trade, and service industries have grown rapidly and accounted for two-thirds of the GDP in 1990-93. At the same time, natural resources required to support infrastructural developments have led to substantial demands that were being placed on the minerals industry, especially in the constructional mineral sector.

The infrastructure bottlenecks and shortages of skilled workers are two major dampening factors for Thai economic growth. The Government continued emphasizing the need to developing the rural areas to diversify the congestion in the Bangkok metropolitan areas.

The income gap between Thailand's rich and poor is widening. According to a study by the Thailand Development Research Institute, the wealthiest 40% of the population received 77% of national income while the poorest 60% accounted for 23% of income in 1993. The institute predicted the distribution ratio to be even more skewed in 1994. The Government believed the development of rural areas would attract job-creating businesses to those areas, thus moving away from Bangkok. The differences in incomes and living standards would mininize.

GOVERNMENT POLICIES AND PROGRAMS

Thailand's economic development policies are based on an export-oriented, free market philosophy. The Government has tried to improve the management of state enterprises and thus has aimed at increasing management flexibility and encouraging private-sector participation through joint investment, shareholding, or concessions in business monopolized by the Government.

According to the Minerals Act of B.E. 2510 (1967) and its sebsequent amendments, the Thai Government has the exclusive ownership of all minerals upon, in, or under the surface of both publicly and privately owned land. Prospecting or mining requires a license or lease. There are four major mining rights: the mineral prospecting license, the exclusive mineral prospecting license, the temporary mining permit, and the mining lease.

The Improvement and Conservation of National Environmental Quality Act, B.E. 2535 (1992), was issued in 1992. The act is administrated by the Office of Environmental Planning and Policy (OEPP). The act mandates that all mining projects are required to submit an environmental impact assessment plan for approval before the commencement of any mining activities and to set up an environmental fund for the Thai economy. The OEPP has the authority to designate any natural area as an environmentally protected area to control its use.

Mining in forest areas is under the Forestry Act, B.E. 2484 (1941), and the National Reserved Forest Act, B.E. 2507 (1964). Mining operators must receive permission to use the land from the Royal Forestry Department in addition to obtaining a mining license from the Department of Mineral Resources.

PRODUCTION

The mineral industry in Thailand was an important economic force. In recent years, the mining sector has diminished greatly in relative importance with the rapid rise of the manufacturing and services sectors. The new regulations under the umbrella of the National Environment Act also constrained the mining sector for expansion. The value of mineral exports has fallen from 15% to less than 1% of Thailand's total exports. The number of individuals employed in the mining sector has dropped from a peak of nearly 100,000 in 1980 to less than 40,000 in 1993.

There are more than 40 minerals produced in Thailand; however, only about 20 are considered to be economically significant. The major minerals produced were feldspar, kaolin, lignite, limestone, tin, and zinc. Zinc has replaced tin as the major metallic mineral produced and consumed domestically. In 1993, the total production value of all

minerals was $740 million. The production of major mineral commodities are listed in table 1.

TRADE

The United States remained the most important export market for Thailand. In 1993, Thailand exported $8.5 billion to the United States and imported $3.8 billion from the United States. The second largest market was the European Community, followed by the Association of Southeast Nations. Growth in exports of textiles, plastic products, computers, and electronics was strong.

In 1993, the total export value for minerals dropped to about $120 million. The tin and zinc prices slump in the international market and the strong demand in the domestic market were the two major reasons for the decrease in the export of minerals.

STRUCTURE OF THE MINERAL INDUSTRY

Minerals are counted as state-owned properties. All activities regarding mineral development are supervised by the Government to ensure that benefits will be maximized for the country. All mining companies are privately owned, except the lignite mine at Mae Moh in Lampang Province, which is owned by the Electricity Generating Authority of Thailand (EGAT), a state enterprise designated to mine lignite for power generation. Most mining companies in Thailand conduct small-scale operations. There are several large-scale mines in Thailand such as the zinc mine owned by Padaeng Industry Co. (PDI); lignite mines operated by EGAT; Lanna Lignite Co., Ban Pu Co., and a lead mine operated by Kanchanaburi Exploration and Mining Co. (KEMCO).

The country's mineral resources are distributed throughout the country. Petroleum occurrences are in the Gulf of Thailand, in a northern offshoot of the central plain, and in the central part of the Khorat basin in northeast Thailand. Principal companies and operating locations are shown in table 2.

COMMODITY REVIEW

Metals

Copper.—The multinational copper project involving Australia, Japan, Switzerland, and Thailand to build a 150,000-mt/a smelter in Rayong was dropped. After the completion of the feasibility study for the project, the main partner, PDI of Thailand, withdrew from the project in view of the loosening of the world's supply and the Thai Government reducing the tariffs on copper.

Padaeng Poongsan Metal, a joint venture of PDI of Thailand and Poongsan Corp. of the Republic of Korea, decided to defer its expansion plan from its current level of 15,000 mt/a to 20,000-30,000 mt/a at its copper fabricator plant. The demand on the domestic market was weak.

Oriental Copper Co., Ltd., a joint venture of World Biz Trade Co., Ltd. of Thailand and Consolidated Extrusions of Australia, planned to build a $25 million copper extrusion busbar plant in Thailand. The plant will have an annual capacity of 12,000 tons. The facility will be commissioned in early 1995. About 30% of its copper products will be exported to neighboring Southeast Asian countries.

PDI and Phelps Dodge Mining Co. of the United States agreed to form a joint venture to explore copper deposit sites in northeast Loei Province. Initial exploration results indicated that the ore contained about 0.4% of copper and could be refined into an estimated total of 740,000 tons of copper metal.

Gold.—Aokam Thai/Tongkah Harbour Group announced its subsidiary, the Cholsin Co., will start producing gold bullion in its Toh Moh Gold Mine in the Narathiwat Province in January 1994. Mining of gold ore from the mine has been underway for some time, but the processing of the ore has just started. The deposit contains about 5 g of gold per ton of ore. The mine has a daily output capacity of 500 g of gold. The gold bullion is expected to be about 95% to 96% purity.

Newmont-Ban Kham, a joint venture of Newmont Gold Co. (70%) of the United States and Ban Pu Mine Thailand Public Co. (30%), discoverd a substantive gold deposits at Den Chai, Long and Wang Chin districts in Phrae Province, and at Si Satchanalai district in Sukhothai Province. Since 1992, the company has been exploring on the leased 795-km^2 area.

Tungkum Ltd., a joint venture of Niugini Mining (45%) of Papua New Guinea and Tongkah Harbour (41.36%) and Sintana Resources (13.64%) of Thailand, completed initial exploration of its gold concession at Loei. Six targets were identified. One of the targets may contain about 4 Mmt of ore, with an average grade of 1.8 g/mt gold at the surface channel. Higher graded gold is detected 54 m below the surface. Further drill testing will continue in 1994.

Iron and Steel.—The Thailand Board of Investment approved the Nam Heng Steel to construct a 250,000-mt/a bar and rod mill at Lop Buri, 130 km north of Bangkok. The mill will be equipped with a 50-ton 40-MV•A arc furnace and a continuous billet caster and rolling mill. Scrap steel will be supplied from the domestic and international markets. The mill was expected to be commissioned in November 1995.

Sahaviriya Steel Industries started trial runs on its 2.4-Mmt/a hot strip mill in December 1993. The strip mill is at Bang Saphan on the coast of the Gulf of Thailand. Commerical production will begin in February 1994. The feeding slabs will be imported. The mill was expected to produce pipe, sheet, and tube for the Thai market.

Siam Cement Group of Thailand, Pohang Iron and Steel Co. of the Republic of Korea, and the Japanese Nippon Steel Corp. and Mitsui Products Co. agreed to form a joint-venture group to build a 800,000-mt/a cold-rolling mill in the Mab Ta Pud industrial park, south of Bangkok. The group was seeking approval from the Board of Investment of the Thai Government.

Lead and Zinc.—PDI signed a joint-venture agreement with Kanchanaburi Exploration and Mining (Kemco), with a 60-40 split, to undergo lead and zinc exploration and mining activities in Kanchanaburi, west of Bangkok. The new company will study how to improve the supply ore from the Kemco mine to Padaeng's zinc refinery in Tak Province. PDI was seeking new zinc resources to replace dwindling initial reserves of 4.3 Mmt silicate zinc deposit with an average of 28% zinc at its Mae Sot Mine in Tak Province near the Burma (Myanmar) border.

PDI and Vietnam's Thai Nguyen formed a joint-venture company to explore for lead and zinc deposits in the Cho Dien area in Bac Thai Province. The area had proven reserves of about 60,000 tons and potential reserves of about 3 Mmt of zinc sulfide. The average zinc content is 10% in the deposit. PDI planned to convert its zinc smelter in Tak from silicate zinc ore into zinc sulfide ore feeds.

Because of financial difficulties, Metallgesellschaft (MG) decided to cancel its $300 million zinc smelter joint venture with PDI at Rayong in Thailand. PDI also decided not to go ahead with the project. Instead, PDI planned to devote its resource to expand its zinc smelter in Tak from 70,000 mt/a to 90,000 mt/a.

Tin.—Depressed world tin prices had hit the tin mining and smelting industry in Thailand. According to the Department of Mineral Resources, 86 tin mining operations were forced to close in 1991 and 1992. This caused a shortage in tin concentrate supply in Thailand. Because of this, Thai Pioneer Enterprises was forced to close down its operations in Pathum Thani. Thailand Smeltering and Refining Co. (Thaisarco), owned by Billiton of Netherlands, had to import more concentrate from Australia to keep its smelter in Phuket running. Only two of the company's four smelting circuits are in operation. One is used for processing domestic concentrates while the other is operated to treat imported concentrates. The company installed an integrated sulfur dioxide scrubber at its Phuket smelter to meet future more restrictive environmental regulations.

Thailand's Roong Siam Mining (Myanmar) and Burma's state-owned No. 2 Mining Enterprise signed a production-sharing agreement for offshore tin exploration and exploitation off the Gulf of Martaban on October 12, 1993.

Industrial Minerals

Potash.—Asia Pacific Resources (APR), based in Vancouver, Canada, completed a 2-year exploration and development program on a potash resource at Udon Thani, Thailand. A high-grade potash deposit was identified at a shallow depth of 300 m. Initial drilling indicated grades ranging from 20% to 30.8% potassium oxide. APR has a 75% interest in the Udon Thai concession and will hold the interest as equity in Asia Pacific Potash Corp. Other shareholders include Thai Central Chemical Corp. (15%) and the Thai Government (10%). The potash deposit is the third potash prospect in Thailand. Other deposits are in Chiya Boom and Bamnet Narong in the southern Khorat Plateau.

Mineral Fuels

Thailand lacks large mineral fuel reserves. The country relied on imports to meet its petroleum and other energy demands. Thailand's energy policy has concentrated on reducing the country's dependence on imported energy by developing indigenous energy resources and promoting energy efficiency. Thailand's Seventh Five-Year Plan (1992-96) continued to stress securing stable sources of energy supply at a reasonable price. Thailand was accelerating indigenous energy resource development and was participating in the development of energy resources in neighboring countries. There are nine fields producing gas and condensate. Baanpot, Erawan, Funan, Kaphong, Platong, Satun, South Satun, and Surat of Unocal in the Gulf of Thailand, and Shell Sirikit in central Thailand produce gas and condensate. Esso's Nam Phong Field in the northeast of Thailand produces gas only. There are five fields in central Thailand that produce crude oil: Shell's Pru Krathiam and Pratu Tao; BP's Neung and Sawng; and North Central International's Bung Ya.

Thailand is struggling with expectations of the high demand for electricity and the high capital costs for constructing new powerplants. EGAT sought Government approval for a partial privatization to raise funds to build new powerplants. Currently, the total installed generating capacity is 12,652 MW. Based on the Eighth Five-Plan (1997-2001) for economic and social development, the capital expenditure required to build additional powerplants is about $5 billion per year. Coal and gas will be a cornerstone for the Thai energy policy. Because of public opposition, EGAT decided to abandon the plan to build two 1,000-MW nuclear plants in Thailand.

Natural Gas.—The Bongkot Gas Field, owned by the Petroleum Authority of Thailand (PAT), Total of France, British Gas, and Statoil of Norway, came on-stream on July 11, 1993. The gas reserve at the Bongkot Gas Field was estimated at 43 billion m^3. An initial gas flow rate was 4.2 Mm^3/d from 12 wells.

The Thai Government dropped to build a pipeline to transport gas from Malaysia to a powerplant at Bang Sa Phan, Thailand. However, Malaysia's state-owned Petronas could not supply a projected gas volume to justify the substantial investment in the project. Construction of a powerplant at Bang Sa Phan also was canceled.

PAT and the Burma Government agreed on the route of 400 km of pipeline to transport natural gas in the Yadana Oilfield in the Gulf of Martaban to Thailand. The Yadana Oilfield was confirmed to have 170 billion m^3 of gas reserves. Construction of the pipeline will cost about $600 million, which will be funded by Total of France and Unocal Corp. of the United States.

After 22 years, the Thai and the Malaysian Governments finally agreed on

joint exploration in the 7,250-km^2 disputed area off the coast of Malaysia and Thailand. Reports suggested that the area contained 108 billion m^3 of natural gas. The Malaysia-Thailand Joint Authority (MTJA) was set to assume all rights and responsibilities on behalf of the two Governments. Three separate production-sharing contracts would be signed for further exploration activities. Triton Oil of the United States, which has the right for exploration in the area from the Thai Government, will sign one of the three contracts with Petronas Carigali, the subsidiary of Malaysia's state-owned Petronas, in 1994. Another two contracts will be signed between PAT and Petronas Carigali. The contract will last for 35 years and involve a 50-50 split between MTJA and the contractors. A 10% royalty will be divided between the two Governments. Both Governments agreed to reduce tax and duty rates in the area by 50%.

Reserves

Thailand is endowed with diverse mineral resources. There are extensive deposits of salt-type minerals such as rock salt and potash. Gypsum, feldspar, limestone, kaolin, glass sand, diatomite, dolomite, and barites also are present in a substantial amount. Exploration in Thailand has been aggressive and well organized, utilizing high-technology methods. Land-use conflicts between mineral resource development and other sectors have become a major source of difficulty for the mining industry in Thailand. The conflicts have become so serious that emerging from the exploration activities will become more complex. Reserves of major mineral commodities are shown in table 3.

INFRASTRUCTURE

Thailand has 3,940 km of 1-m-gauge railroad, extending to most parts of the country, and 99 km of double track. The country has a total 44,534 km of highway, including 28,016 km of paved, 5,132 km of earth surface, and 11,386 km of under development surface. Thailand has 4,000 km of inland waterways, with 3,700 km of this navigable with 0.9 m or more draft throughout the year and others with minor waterways navigable by shallow-draft native craft.

Bangkok, Pattani, Phuket, Sattahip, and Si Racha are Thailand's major seaports. At least 15 other minor seaports are elsewhere along the Thai coast. The country has a total of 129 airfields. Among them, 103 are usable. Permanent, paved runways are utilized at 56 of these fields, 1 with runways of more than 3,659 m; 12 with runways 2,440 to 3,659 m; and 28 with runways 1,220 to 2,439 m. Navigation aids are modern and sophisticated.

OUTLOOK

The Thai Government is promoting the development of the petrochemicals industry on a priority basis to fully exploit natural gas from the Gulf of Thailand. The Government sees such an industry as a means to add value to the gas, to provide raw materials at internationally competitive prices for downstream industries, to boost Thailand's exports, to develop the manufacturing industry, and to promote employment through the growth of labor-intensive downstream industries such as textiles.

The Thai Government recognizes the importance of energy conservation as a means of coping with rapidly increasing demand for both electricity and refined petroleum products. However, it has so far implemented only a few concrete measures. In a major step to combat Bangkok's severe air pollution by motor car emission, the Government will require that all refineries produce unleaded gasoline by September 1993.

On the whole, Thailand bodes well to grow into a major economic and industrial nation through tax reforms to stimulate production, investment, and export. Thailand's economic policy will continue to emphasize production efficiency and competitiveness of its export.

[1]Where appropriate, values have been converted from Thai baht (B) to U.S. dollars at the rate of B25.00=US$1.00 in 1993.

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132 Sinthorn Building
Room 11, Wireless Road
Bangkok 10500, Thailand

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Bangkok 10500, Thailand.

TABLE 1

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Antimony:							
Ore and concentrate:							
Gross weight		1,166	767	141	632	650	1,200
Sb content e		495	326	60	269	270	500
Metal, smelter		2,275	2,833	2,256	1,847	1,700	3,000
Chromium: Chromite, gross weight		416	—	—	—	—	300
Columbium and tantalum ores and concentrates, gross weight:[2]							
Columbite and tantalite:							
Gross weight	kilograms	109,000	9,000	3,000	e3,000	3,000	7,000
Cb content	do.	18,530	1,530	e510	e500	500	1,200
Ta content	do.	29,430	2,430	e810	e800	800	1,700
Stuverite:							
Gross weight	do.	99,000	122,000	e100,000	e100,000	100,000	150,000
Cb content	do.	7,958	9,807	e8,040	e8,000	8,000	10,000
Ta content		7,703	9,492	e7,780	e7,800	8,000	10,000
Iron and steel:							
Iron ore:							
Gross weight		177,373	128,626	240,075	427,242	450,000	500,000
Fe content		97,555	70,744	132,040	234,980	250,000	300,000
Metal: Steel:							
Crude		689,421	684,678	711,134	779,156	800,000	1,000,000
Semimanufactures (selected):							
Bars		498,986	597,899	620,438	1,019,689	1,100,000	1,300,000
Galvanized iron sheets		200,616	208,483	210,953	217,332	220,000	250,000
Tinned plates		149,478	173,110	190,386	226,368	240,000	270,000
Lead:							
Mine output, Pb content of 42.5% Pb concentrate		25,075	22,231	16,680	27,946	14,200	30,000
Metal: Ingot, secondary		18,711	15,861	12,843	18,906	18,500	20,000
Manganese ore:							
Battery and chemical grade, 75% MnO_2		3,115	2,405	2,539	1,676	1,500	3,000
Metallurgical grade, 46% to 50% MnO_2		7,930	14,247	8,493	6,151	6,000	10,000
Total, gross weight		11,045	16,652	11,032	7,827	7,500	13,000
Total Mn content		5,301	7,993	5,300	3,800	3,500	7,000
Rare-earth minerals:							
Monazite concentrate, gross weight		631	377	400	89	100	500
Xenotime		35	14	15	e15	15	20
Tin:							
Mine output, Sn content		14,922	14,635	14,937	11,484	6,400	15,000
Metal, smelter, primary		14,571	15,512	11,255	10,679	7,700	15,000
Titanium:							
Ilmenite concentrate, gross weight		16,955	10,554	17,071	2,922	20,700	25,000
Leucoxene concentrate, gross weight		30	120	4	5	5	10
Rutile concentrate, gross weight		—	—	76	281	300	500
Tungsten concentrate:							
Mine output, gross weight		1,086	552	440	125	200	750
Mine output, W content		603	290	230	70	110	380

See footnotes at end of table.

TABLE 1—Continued

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
METALS—Continued							
Zinc:							
Mine output, gross weight		412,620	404,100	496,006	407,180	445,000	500,000
Mine output, Zn content		62,831	61,534	87,000	r62,000	70,000	90,000
Metal, smelter, primary		68,376	63,257	62,152	60,557	62,000	70,000
Zirconium concentrate, gross weight		1,496	490	2,573	1,723	700	2,000
INDUSTRIAL MINERALS							
Barite		87,052	107,707	r100,000	46,328	42,400	75,000
Cement, hydraulic	thousand tons	15,024	18,054	18,054	21,832	23,000	32,000
Clays:							
Ball clay		134,921	183,313	178,192	224,254	346,000	380,000
Kaolin, marketable:							
Beneficiated		176,281	208,029	255,543	301,035	397,000	450,000
Nonbeneficiated		152,266	139,342	125,563	182,255	180,000	200,000
Filler		277	319	733	3,445	3,500	4,000
Diatomite		1,412	4,593	7,328	10,425	10,000	12,000
Feldspar		515,206	311,249	702,603	559,806	560,000	700,000
Fluorspar:							
Crude mine output:							
High-grade		98,375	94,757	60,617	51,597	48,400	70,000
Low-grade		—	—	1,450	4,863	5,000	6,000
Total		98,375	94,757	62,067	56,460	53,400	76,000
Salable product:							
Acid-grade (beneficiated low-grade)		—	—	1,450	4,863	5,000	6,000
Metallurgical-grade		98,375	94,757	60,617	51,597	50,000	70,000
Total		98,375	94,757	62,067	56,460	55,000	76,000
Gemstones	carats	r2,000,000	3,577,000	4,351,641	4,765,820	4,800,000	5,000,000
Gypsum		5,477,237	5,753,351	7,196,390	7,111,109	7,450,000	7,500,000
Phosphate rock, crude		6,584	9,547	5,936	7,981	8,000	10,000
Salt:							
Rock		15,384	119,179	124,500	212,750	200,000	250,000
Other[e]		165,000	100,000	100,000	100,000	100,000	130,000
Sand, silica		296,130	421,508	157,464	r170,000	150,000	250,000
Stone:							
Calcite		2,400	40,160	18,000	17,215	18,000	30,000
Dolomite		257,576	379,548	481,866	331,819	537,000	600,000
Limestone for cement manufacture only	thousand tons	15,966	19,521	19,517	25,272	32,000	35,000
Marble		54,459	55,337	74,984	86,995	88,400	90,000
Marl for cement manufacture only	thousand tons	535	367	718	675	650	700
Quartz, not further described		33,850	22,074	20,312	18,051	20,000	30,000
Shale for cement manufacture only	thousand tons	2,452	2,686	2,448	2,860	2,800	3,000
Talc and related materials:							
Pyrophyllite		39,799	29,290	42,960	34,638	35,000	45,000
Talc		7,242	4,360	5,575	4,786	4,500	6,000
MINERAL FUELS AND RELATED MATERIALS							
Anthracite		8,740	20,600	14,300	22,000	24,000	25,000

See footnotes at end of table.

TABLE 1—Continued

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
MINERALS FUELS AND RELATED MATERIALS—Continued							
Coal: Lignite	thousand tons	8,899	12,421	14,689	15,618	15,600	17,000
Petroleum:							
Crude	thousand 42-gallon barrels	7,793	8,748	8,938	9,632	9,600	10,000
Natural gas condensate	do.	6,731	7,208	7,938	9,676	9,600	10,000
Refinery products:							
Liquefied petroleum gas	do.	2,189	e2,300	e2,350	e2,400	2,400	—
Gasoline	do.	16,980	e18,000	e18,200	e19,000	19,000	—
Jet fuel	do.	10,380	e12,000	e12,000	e12,500	12,500	—
Kerosene	do.	811	e900	e900	e900	900	—
Distillate fuel oil	do.	6,493	e28,000	e28,400	e28,500	28,500	—
Residual fuel oil	do.	21,933	e22,000	e22,300	e22,500	22,500	—
Unspecified[3]	do.	3,000	e3,300	e3,400	e3,400	3,400	—
Total	do.	81,786	e86,500	e87,550	e89,200	89,200	90,000

eEstimated.
[1]Includes data available through July 28, 1994.
[2]Excludes columbium and tantalum bearing tin slags.
[3]Includes refinery fuel plus refinery gains or losses.

TABLE 2

THAILAND: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Antimony, concentrate	Associated Minerals Co. Ltd.	Bo Thang, 130 kilometers southeast of Bangkok (temporarily inactive)	6
Do.	Parasit Mining Co.	Doi Ngoem, 100 kilometers southeast of Chiang Mai	2
Barite	American Thai Barite Co. Ltd.	Siam Mine, 200 kilometers southeast of Phuket	25
Do.	P&S Mining Co. Ltd.	Loei Mine, 10 kilometers northwest of Loei	70
Do.	STA Mining Co. Ltd.	STA Mine, 105 kilometers southeast of Chiang Mai	100
Cement	Siam Cement Co. Ltd.	Kaeng Khoi, 90 kilometers north of Bangkok	3,300
Do.	do.	Tambol Tabkwang, Kaeng Khoi District, 90 kilometers northeast of Bangkok	2,800
Do.	do.	Tha Luang, 90 kilometers northeast of Phuket	3,200
Do.	do.	Thung Song, 130 kilometers east of Phuket	900
Fluorspar, concentrate	Phanom Thuan Mining Co. Ltd.	Phanom Thuan, 45 kilometers north of Kanchanaburi	60
Do.	Skt Minerals Co. Ltd.	Mine is 47 kilometers southeast of Krabi	65
Do.	Thai Fluorite Processing Co. Ltd.	Ban Lad, Phet Buri	120
Do.	United Fluorite Co. Ltd.	Salak Pra, 80 kilometers northwest of Kanchanaburi	26
Do.	Universal Mining Co. Ltd.	Mae la Luang, 120 kilometers west of Chiang Mai	35
Lead, concentrate	Kanchanaburi Exploration and Mining Co. Ltd.	Song Toh, 250 kilometers northwest of Bangkok	45
Steel, rolled	Bangkok Iron & Steel Co. Ltd.	Bangkok	160
Do.	Bangkok Steel Industry Co. Ltd.	Samut Prakan Province, south of Bangkok	210
Do.	Siam Iron & Steel Co. Ltd.	Saraburi Province, 100 kilometers north of Bangkok	220
Tantalum and niobium, in tin slag	Thai Tantalum Co. Ltd.	Rayong	500

See footnotes at end of table.

TABLE 2—Continued

THAILAND: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Tin:			
Concentrate	Numerous small companies	Offshore Andaman Sea from southern tip of Burma to south of Phuket	NA
Do.	do.	Mostly south Thailand and along southern Burma border	NA
Refined	Thailand Smelting and Refining Co. Ltd.	Phuket	38
Tungsten, concentrate	Parasit Mining Co.	Doi Ngeom, 100 kilometers east	.1
Do.	Siamerican Mining Enterprise Co. Ltd.	Khao Soon, 185 kilometers east of Phuket (temporarily inactive)	1.2
Do.	Sirithai Scheelite Thailand Co. Ltd.	Doi Mok, 120 kilometers northeast of Chiang Mai (temporarily inactive)	.4
Zinc:			
Ore	Padaeng Industry Co. Ltd.	Mae Sot, 64 kilometers west of Tak	350
Refined	Do.	Tak	70

NA Not available.

TABLE 3

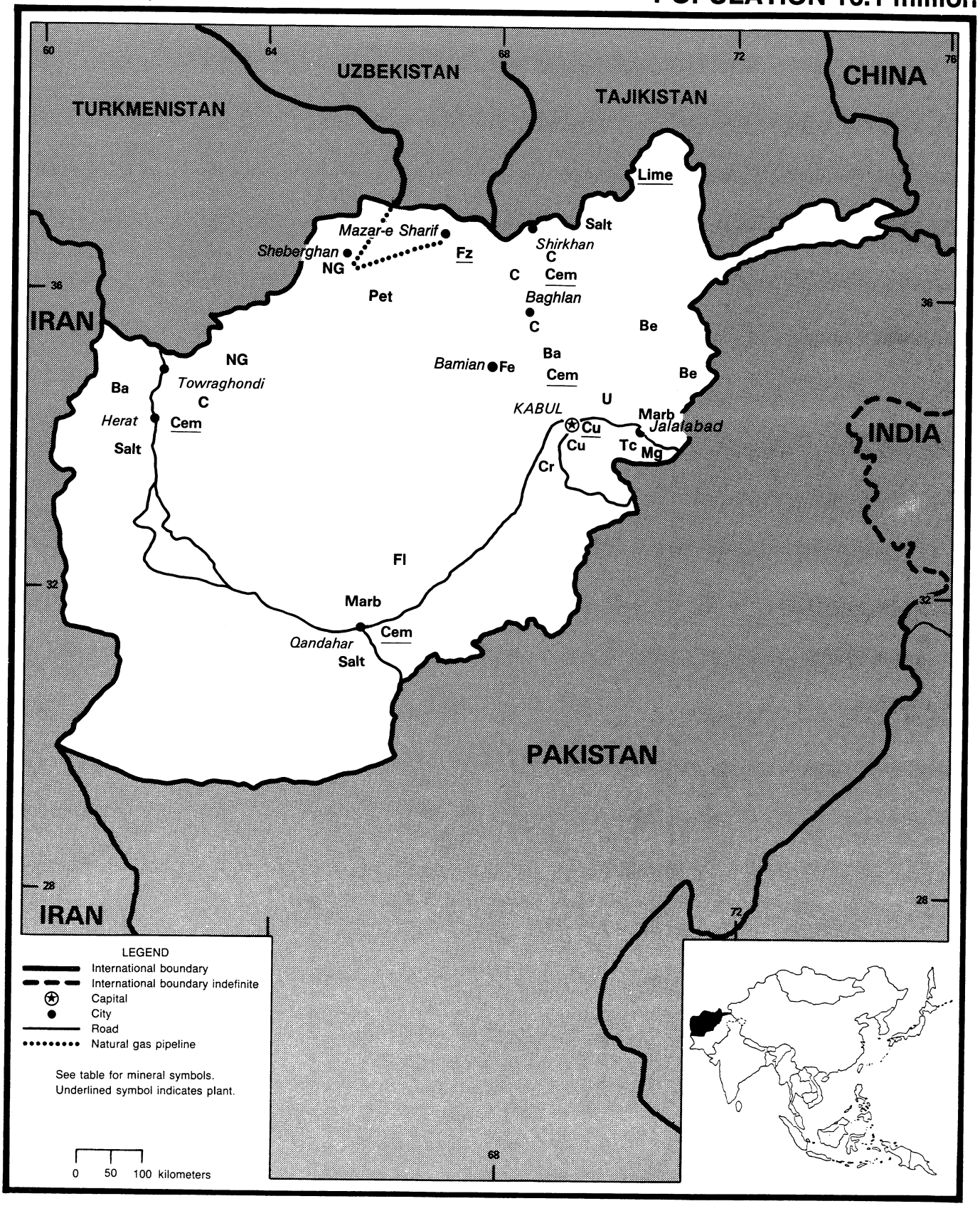
THAILAND: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Reserves
Antimony	300
Barite	14,000
Clay, kaolin	500
Feldspar	43,000
Fluorspar	1,000
Gas, natural billion cubic meters	455
Gypsum	42,300
Lead	1,500
Lignite	2,100,000
Limestone	5,500,000
Petroleum, crude million barrels	325
Potash	570,000
Tantalum (including tantalum-bearing tin slags)	3,000
Tin	270
Tungsten	3
Zinc	3,800

AFGHANISTAN

AREA 647,500 km² **POPULATION 16.1 million**



THE MINERAL INDUSTRY OF

THE OTHER ASIA AND THE PACIFIC

By Staff, Branch of Asia and the Pacific

AFGHANISTAN[1]

The country's economic development played second to political and military upheavals. Rebels ousted Afghanistan's Russian-backed Communist government in April 1992 after a 14-year civil war. Since then, Government factions and rival militias continued fighting in Kabul where an estimated 70% of workers were unemployed. The majority of the work force was in agriculture and animal husbandry (67.8%) and industry and construction (16.5%). Economic growth was essentially nil because of the loss of labor and capital and the disruption of trade and transport. Existing infrastructure had been destroyed by the civil war.

Various warlords governed regions centered around the cities of Mazar-e Sharif, Herat, and Jalalabad. Each region made its own arrangements to provide food and supply goods to itself. There was virtually not much industrial production in these cities, and their economies were geared around considerable trade, although mostly smuggling from neighboring countries.

Afghanistan is a landlocked country where the terrains are mostly rugged mountains. Besides oil and gas, a number of mineral resources was reported to have been found in the country. They included barite, coal, copper, iron ore, lead and zinc, precious and semiprecious stones, salt, sulfur, and talc. These discoveries were made during the occupation of the former U.S.S.R.

Industrial growth was below 2% and output accounted for only 25% of gross domestic products. Small-scale operations to produce cement, coal, copper, fertilizer, natural gas, and oil were most common. The small mineral industry played a minor role in the country's economy. Perhaps the best known mineral product from the country was the gemstone, lapis lazuli.

Natural gas was the most significant product of the country and accounted for 55% of exports. Eighty percent of gas output was destined for the northern neighboring republics. Afghanistan imported mostly foodstuff and petroleum products such as liquid fuel and aviation bunkers. The major trading partners were Pakistan and the former Soviet Central Asian republics.

There was no significant donors' economic aid for Afghanistan in 1993 except the emergency aid the United Nations (UN) was able to provide. The UN aid program had been limited largely to rehabilitating returning refugees by providing startup money, seeds, and fertilizer. The UN allocated $37 million[2] in a demining program to clear millions of mines left behind.

Afghanistan and the Czech Republic exchanged views on the prospects for economic and technical cooperation and the expansion of trade relations. The Jabal-e Seraj and Ghori cement plants were to be reopened and installed with equipment from the Czech Republic. The remaining work of a second cement plant at Ghori that was interrupted by factional fighting was to be completed in the near future.

Infrastructure development was almost nonexistent. Little reconstruction was carried out by a small team of UN workers. Several roads, corrugated, and decaying asphalt strips were being relaid. Canals being neglected for 14 years were being cleaned. The country's power generating capacity is rated at only 480 MW, 60% hydroelectric and 40% thermal. There are pipelines from Uzbekistan to Bagram for petroleum products and from Turkmenistan to Shindand for natural gas. The thermal powerplant and nitrogen fertilizer plant at Mazar-e Sharif received natural gas piped from the gasfields in the Sheberghan area.

TABLE 1
AFGHANISTAN: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Barite		2,000	2,000	2,000	2,000	2,000	3,000
Cement, hydraulic		100,000	112,000	112,000	115,000	115,000	114,000
Coal, bituminous		125,000	180,000	170,000	175,000	180,000	180,000
Copper: Mine output, Cu content		5,000	5,000	5,000	5,000	5,000	—
Gas, natural:							
Gross	million cubic meters	2,100	2,400	2,500	2,600	2,700	3,400
Marketed	do.	1,800	2,100	2,200	2,300	2,300	—
Gypsum		3,000	3,000	3,000	3,000	3,000	—
Natural gas liquids	thousand 42-gallon barrels	30	30	35	35	35	—
Nitrogen: N content of ammonia		40,000	40,000	40,000	40,000	30,000	—
Salt, rock		10,000	10,000	12,000	12,000	13,000	—

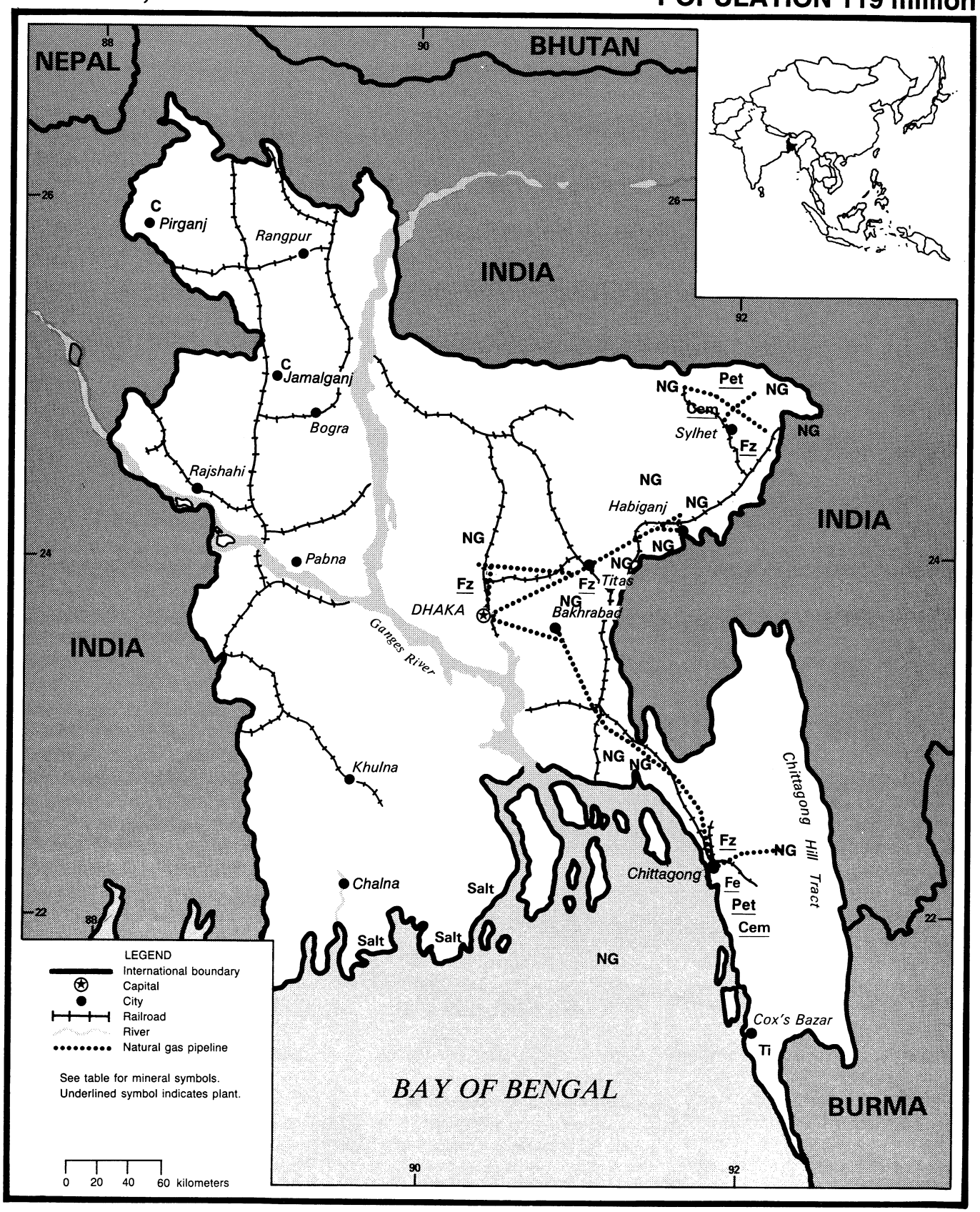
[e]Estimated.

[1]Table includes data available through Aug. 8, 1994.

[2]In addition to the commodities listed, asbestos, lapis lazuli, uranium, and a variety of crude construction materials (clays, stone, and sand and gravel) presumably are produced, but available information is inadequate to make reliable estimates of output levels.

BANGLADESH

AREA 144,000 km² **POPULATION 119 million**



BANGLADESH[3]

Bangladesh's economy appeared to be healthy with a record-low inflation rate at 2% per year, bulging foreign reserves, and a reduced current account deficit. Economic growth was about 5% in 1993, aided by a bumper rice crop and a spectacular growth in the export garment industry. The country needed to create a more stable environment to encourage more long-term local investment and eventually foreign investment as well. Foreign investment in general slumped, with 30% of foreign investors pulling out of the country.

The Government ended some foreign exchange restrictions, among them the need for approval of royalty and other payments. It also planned to make the taka fully convertible in October. Capital machinery bought by export industries was exempted from import duties. Foreign investors requested yet greater freedom to add to their 10-year tax holidays and duty-free imports of equipment and materials in the Export Processing Zones.

Output from industry contributed only 10% of gross domestic product. Industrial growth increased moderately in the production of jute goods and significantly in the production of urea and ammonium sulfate, as well as garment. The public-sector industries accounted for only one-fourth of the country's industrial production and were money losers. The Government privatized six public enterprises to increase private and foreign participation.

The country earned $2.34 billion[4] with its exports during the fiscal year 1992-93, up 22% from that of the previous year. Export items included garments, jute and jute products, leather, knitwear, and primary goods. Goods worth $113 million were exported from the Export Processing Zones. There are two existing zones: one at Chittagong and the other at Dhaka, the latter opened in June. These zones accounted for almost all of the country's new foreign investment in recent years.

A $510 million Karnaphuli fertilizer plant in Chittagong, a joint venture between the Government (40%), foreign aid donors and Japanese companies led by Chiyoda, was to come on-stream in October of 1994. Financing of the project was 75% in a Government-backed $400 million loan and 25% in equity. The plant planned to use Bangladesh's natural gas in northern fields as fuel for fertilizer production. An Ashuganj-Bakharabad pipeline was to bring natural gas south to the plant, but construction and financing were still in doubt. The Government promised to supply the plant with gas from Bakharabad and Feni for 2 to 3 years. The company was to export 500 mt/d of ammonia and 1,725 mt/d of urea, mainly to China and India.

In the oil and gas sector, the Government put into effect in July a new national petroleum policy intended to speed private-sector investment in oil exploration and development. The state oil company, Petrobangla, had opened almost the entire country's oil sector to competitive bids from international oil companies. Holland Sea Search of the Netherlands and Cairns Energy of the United Kingdom were the first of seven international oil exploration groups to complete exploration and production agreements. Other potential foreign companies included Occidental Petroleum Corp. of the United States and Total of France.

Eastern Refinery Ltd. added a $625,000 secondary recovery unit at its 31,200-bbl/d Chittagong refinery. This addition gave the plant capability to process 500,000 mt/a of fuel oil, 14,000 mt/a of diesel, 1,500 mt/a of naphtha, and 1,500 mt/a of liquefied petroleum gas. The country consumed petroleum products at an average of 40,000 bbl/d and demand was increasing at a rate of 2.5% to 3% per year.

The country has 303 billion m^3 of gas reserves, 70 Mbbl of condensate in the 17 gasfields discovered so far. A total of 1.64 Mm^3/d of gas, 1,000 bbl/d of condensate, and 150 bbl/d of crude oil was produced from five new gasfields and one oilfield. Bangladesh Gas Fields Co. Ltd. and Sylhet Gas Fields Ltd. together produced 17.98 million m^3/d of gas, 1,000 bbl/d of condensate, and 200 bbl/d of oil.

To meet chronic power shortages, the Government planned to tap nuclear energy and look for sources of funding to build a $600 million, 300-MW nuclear plant. At the same time, the country was courting foreign investors to set up gas- or coal-fired thermal powerplants. International Energy Group of the United States and RP Goenka Group of India proposed plans for building and operating privately owned powerplants. Japan granted Bangladesh a $220 million concessional loan to upgrade three powerplants and study development of the Chittagong airport and a port project in Dhaka. Per capita power consumption in Bangladesh was 80 kW/a, and only 14% of the country was supplied with electricity. The country had an installed capacity of 2,600 MW, but generated only 1,800 MW.

TABLE 2

BANGLADESH: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic[3]		343,990	337,359	274,551	272,577	275,000	410,000
Clays: Kaolin[3]		7,092	7,223	7,338	7,300	7,500	—
Gas, natural, marketed[3 4]	million cubic meters	4,413	4,754	4,893	5,740	6,000	6,000
Iron and steel: Metal:[3]							
Steel, crude (ingot only)		86,274	75,029	57,520	36,384	32,000	—
Steel products		109,161	87,422	95,016	90,000	85,000	200,000
Nitrogen: N content of urea, ammonia, and ammonium sulfate		775,000	700,500	667,300	[r]936,800	[5]990,900	1,000,000
Petroleum:							
Crude	thousand 42-gallon barrels	1,287	1,191	[e]1,200	1,100	1,300	—
Refinery products	do.	7,688	[e]7,500	[e]7,600	7,700	7,800	10,000
Salt, marine[e 3]		415,000	350,000	300,000	320,000	340,000	—
Stone: Limestone[3]		29,457	38,008	42,484	47,000	50,000	—

[e]Estimated. [r]Revised.

[1]Table includes data available through July 27, 1994.

[2]In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

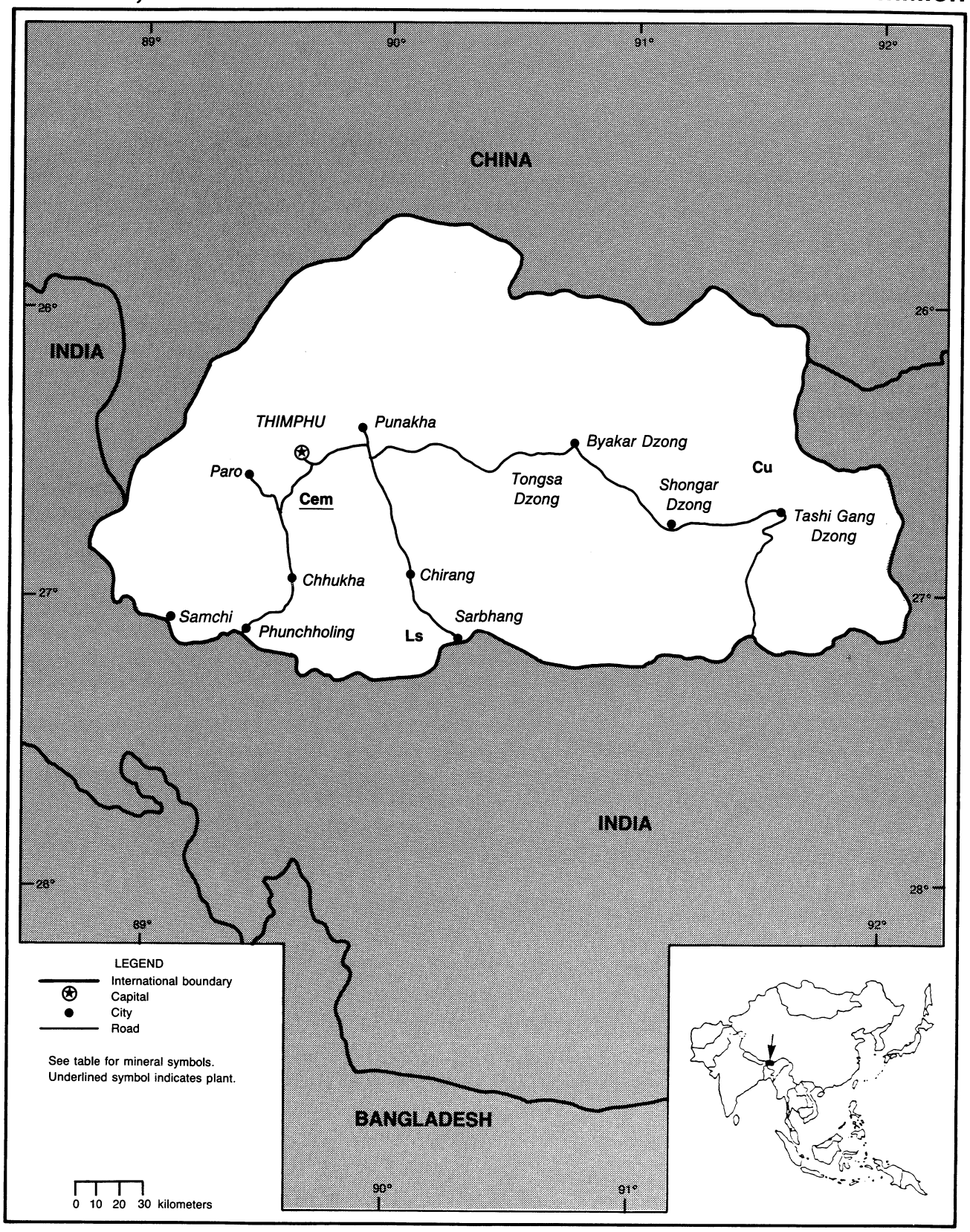
[3]Data are for years ending June 30 of that stated.

[4]Gross production is not reported; the quantity vented, flared, or reinjected is believed to be negligible.

[5]Reported figure.

BHUTAN

AREA 47,000 km² **POPULATION 1.7 million**



BHUTAN[5]

The Kingdom of Bhutan, a landlocked mountainous country with a land area slightly larger than Switzerland, is on the southeast slope of the Himalayas, bordered on the north and east by Tibet of China, and on the south and west by the Assam-Bengal Plain of India. More than one-half of Bhutan is covered with forests. The mineral resources of Bhutan include beryl, coal, copper, dolomite, graphite, gypsum, iron, lead, limestone, marble, mica, pyrite, slate, silver, talc, tin, tungsten, and zinc. Currently, dolomite, gypsum, limestone, sand and gravel, and slate were being mined for the manufacture of calcium carbide, cement, and construction materials. Small quantities of coal, copper, graphite, iron, and silver have been mined in past years.

Bhutan's mining sector, composed of several small-scale mining firms for industrial minerals, is the smallest sector of Bhutan's economy. The output of the mining and quarrying industries, according to the latest United Nations' statistics, accounted for only 0.9% of the country's gross domestic product (GDP). The total value of minerals output was estimated at $3 million,[6] while Bhutan's GDP was estimated at $340 million in 1993. Bhutan also has a small mineral processing industry, which is composed of a cement plant, a calcium carbide plant, a salt iodization plant, and a ferroalloys plant.

Limestone, produced from the Khanku deposit in Paro district and the Penden deposit in Samchi district in western Bhutan, was mostly for the manufacture of cement. The 155,000-mt/a cement plant at Gomptu, about 50 km south of Thimphu (national capital), is owned and operated by Penden Cement Authority Ltd. Cement production was estimated at 130,000 tons in 1993. In past years, some cement has been exported to Bangladesh and India.

Limestone production from the Hauri Khola, Purbia Khola, Kaleshwar, and Mirchang deposits was for the manufacture of calcium carbide. The combined limestone proven reserves of these deposits were estimated at 500,000 tons. The 22,000-mt/a plant at Pasakha, near Phunchholing in southern Bhutan, is equipped with a 12-MV•A calcium carbide submerged electric arc furnace and a 100-mt/d lime kiln. Bhutan Carbide & Chemicals Ltd. (BCCL), the operator of the plant, is 36% owned by the Royal Government of Bhutan, 20% by Tashi Commercial Corp. (TCC), and 44% by public shareholders. According to the International Bank for Reconstruction and Development, the plant began commercial operation in June 1988. Production of calcium carbide had reached full capacity since 1991. All calcium carbide output was exported to India.

Reserves of most of Bhutan's minerals were unknown largely owing to the difficulty of access to much of the country with its high relief and lack of roads. Systematic exploration and geologic mapping are still in an incipient stage. However, the Himalayas are known to include thick sequences of carbonate rocks, and Bhutan's mineral reserves of dolomite and limestone were considered to be large. Likewise, quartzite reserves were considered to be large. Reserves of quartzite recently have been estimated at 5.5 Mmt in the Samchi mining district of western Bhutan.

Bhutan has 1,304 km of roads, of which 418 km is paved, 515 km improved, and 371 km unimproved. There are two airports, but no rail network in Bhutan. Telecommunication links only with India. Bhutan's main power source was from its 336-MW giant Chukha hydroelectric power stations on the Wangchu River of southwestern Bhutan. The power stations not only provided electricity to central and southern Bhutan but also sold a substantial part of the output to India. With two to three other small powerplants, Bhutan's total installed capacity was estimated at more than 350 MW.

Bhutan's economy is one of the least developed in the world. Its development is largely dependent on foreign financial and technical aid from India, Japan, and international organizations. Cooperation between Bhutan and India in the power sector is expected to continue, and mineral trade is expected to expand into countries other than India when the ferroalloys plant comes on-stream in 1993 and cement production increases in the next few years. However, Bhutan's economic development will require upgrading of its infrastructure, such as highway network expansion, telephone system modernization, and hydroelectric power generation capacity expansion. Further mineral exploration is a prerequisite to growth in Bhutan's small mining sector.

TABLE 3
BHUTAN: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

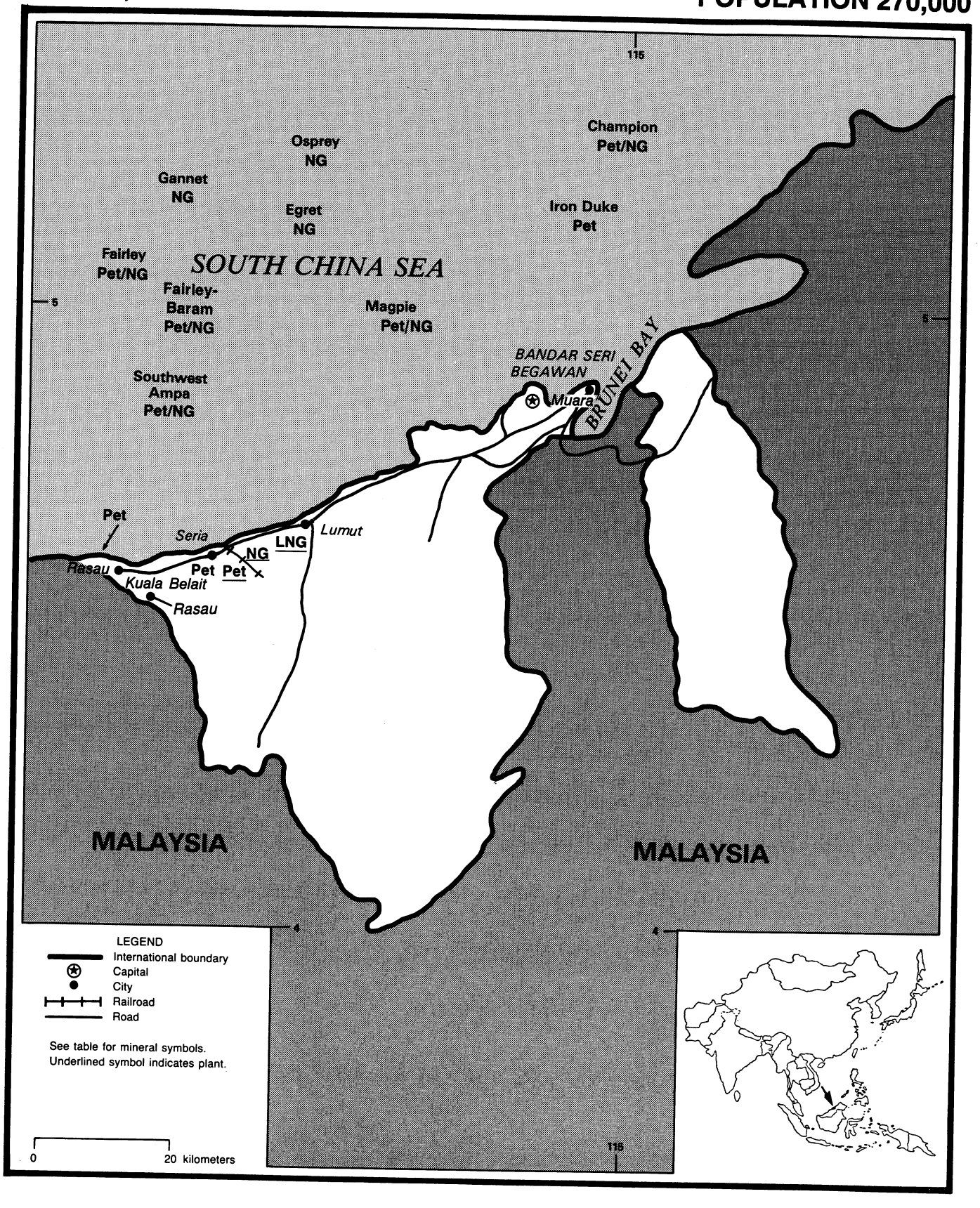
Commodity[2]	1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Cement	151,676	153,000	153,000	127,000	130,000	160,000
Dolomite	90,000	100,000	90,000	90,000	90,000	120,000
Gypsum	22,000	22,000	22,000	20,000	20,000	25,000
Limestone	200,000	220,000	220,000	190,000	198,000	250,000

[1]Table includes data available through Aug. 12, 1994.
[2]In addition to the commodities listed, crude construction materials such as sand and gravel and a variety of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

BRUNEI

AREA 5,770 km²

POPULATION 270,000



BRUNEI[7]

Brunei, on the northwest coast of Borneo Island, has extensive reserves of petroleum and natural gas. Brunei, despite its small land area, was the world's fourth largest producer of liquified natural gas (LNG). Brunei remained the sixth largest producer of crude petroleum, the seventh largest producer of natural gas, and the fourth largest producer and exporter of LNG in the Asia and the Pacific region. Mining activity in Brunei involved only the production and processing of crude petroleum and natural gas. The oil and gas sector, which employed about 6,000 workers or 7% of the total work force, contributed about 65% of Brunei's gross domestic product (GDP) and provided about 55% of Government revenues. Brunei joined the membership of the General Agreement on Tariffs and Trade in December 1993.

Brunei's GDP was estimated to have grown by 3% to $3.9 billion.[8] The economic growth of this small sultanate is almost entirely dependent on increased production and exports of crude petroleum and natural gas. Exports of crude petroleum, natural gas (in the form of LNG), and refined petroleum products accounted for about 96% of Brunei's export earnings. In 1993, Brunei's export earnings were estimated at $2.7 billion, of which about 46% was from exports of LNG, 43% from exports of crude petroleum, and 7% from exports of refined petroleum products. In 1993, Japan remained the dominant importer of Brunei's crude petroleum and LNG. The Republic of Korea, Singapore, and Thailand were other major export markets of Brunei's crude petroleum and refined petroleum products.

Production of oil and gas by Brunei Shell Petroleum Co. Sdn. Bhd. was from six offshore fields—South West Ampa, Champion, Magpie, Fairley, Fairley-Baram, and Gannet; and from three onshore fields in Gannet, Serai, and Rasau in 1993. Brunei Shell Petroleum Co. Sdn. Bhd., a 50-50 joint venture of Royal Dutch Shell Group Co. and the Government of Brunei, was the country's only producer of crude petroleum and natural gas. To meet domestic demand for refined petroleum products, Brunei Shell operated a 8,500-bbl/d petroleum refinery at Seria. Major refined petroleum products included gasoline and distillate fuel oil.

Production of crude petroleum decreased from an average of 165,000 bbl/d in 1992 to an average of 163,000 bbl/d in 1993, of which about 69% was from the South West Ampa and Champion Fields. During the Gulf war, the Government lifted its own restricted production under the 1988 conservation policy. The output of crude petroleum reportedly had been raised to higher than the planned production in 1993 partially owing to the lower world price of crude petroleum and partially owing to the continuing investment in high-technology exploration to increase oil reserves.

Production of natural gas increased slightly to about 9.6 billion m^3, of which more than 95% was from the South West Ampa, Champion, and Fairley Fields. Brunei LNG Sdn. Bhd. purchased natural gas from Brunei Shell and produced LNG at the Lumut LNG plant with a capacity of 5 Mmt/a. Exports of LNG were about 5.5 Mmt and valued at about $1.25 billion in 1993. Virtually all LNG output was exported to Japan under a new 20-year contract.

The old 20-year contract expired at the end of March 1993. A new 20-year contract between Brunei Coldgas Sdn. Bhd., a marketing arm of Brunei LNG, and three Japanese buyers had been reached in April.[9] The three Japanese buyers are Tokyo Electric Power Co. Inc, Tokyo Gas Co. Ltd., and Osaka Gas Co. Ltd. Under the newly signed contract, Brunei is to export 5.54 Mmt/a of LNG to Japan, up by 10% from the old 20-year contract. Brunei LNG was owned 50% by the Government of Brunei and 25% each by Brunei Shell and Mitsubishi Corp. of Japan.

As part of the 5-year plant modernization program launched by Brunei LNG in 1989, two new storage tanks with a capacity of 65,000 m^3 each were inaugurated in late 1993. The project cost was estimated at $128 million. The two new tanks replaced the old three LNG storage tanks, which had been used for the past 20 years.[10]

In 1993, Brunei Shell announced that it made two significant oil and gas discoveries. Enggang-1 exploration well, on the northern edge of Tali Oilfield off Seria, tested oil at a combined flow of 2,250 bbl/d and gas at 521,000 m^3. According to an official of Brunei Shell, this well was Brunei's first shallow-water success since the Seria/Tali Oilfield of the 1970's. Another offshore gas discovery was about 20 km west of the Champion West Field. However, no test results had been released on this 3,500-m-depth well.[11]

According to oil and gas industry sources, Brunei's estimated proven reserves of crude petroleum and natural gas, as of January 1994, were 1.35 billion bbl and 396.44 billion m^3, respectively.

TABLE 4

BRUNEI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990[p]	1991[e]	1992[e]	1993[e]	Annual capacity[e] (Jan. 1, 1994)
Gas, natural:							
Gross[e]	million cubic meters	9,069	9,447	9,200	9,500	9,600	10,000
Marketed	do.	8,337	8,692	8,240	8,700	8,800	—
Natural gas liquids:[e]							
Condensate	thousand 42-gallon barrels	5,400	3,814	4,000	4,500	4,600	5,000
Natural gasoline	do.	290	285	290	290	290	300
Liquefied petroleum gas	do.	100	90	90	90	90	100
Total	do.	5,790	4,189	4,380	4,880	4,980	5,400
Petroleum:							
Crude	do.	51,830	49,008	r59,130	r62,731	65,700	70,000
Refinery products:[e]							
Gasoline	do.	650	625	630	620	630	700
Distillate fuel oil	do.	450	440	450	430	440	500
Residual fuel oil	do.	10	10	10	9	10	10
Other including refinery fuel and losses	do.	355	340	345	330	340	400
Total	do.	1,465	1,415	1,435	1,389	1,420	1,610

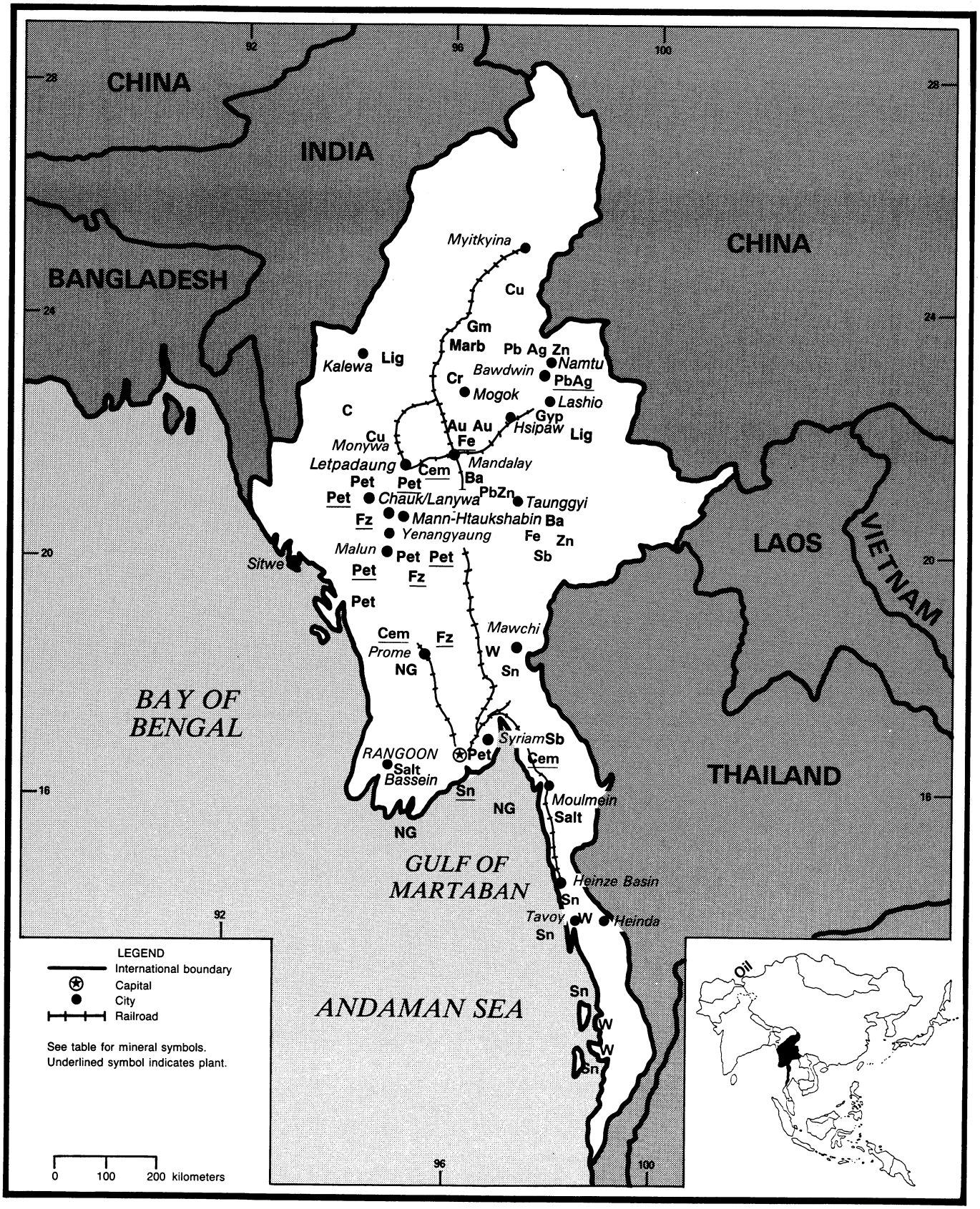
[e]Estimated. [p]Preliminary. [r]Revised.

[1]Table includes data available through Aug. 12, 1994.

[2]In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

BURMA

AREA 678,600 km² **POPULATION 43.5 million**



BURMA (MYANMAR)[12]

Burma, once an important producer and exporter of crude petroleum, lead, silver, and zinc in Asia during the 1950's, produced only modest amounts of metallic minerals, such as chromium, copper, gold, lead, manganese, silver, tin, tungsten, and zinc; industrial minerals, such as barite, clays, dolomite, feldspar, gypsum, limestone, precious stones, and salt; and mineral fuels, such as coal, natural gas, and crude petroleum. Most of the production was for its own consumption. However, most of the jade and precious stones production, such as diamond, rubies, sapphires, and other gems and certain amounts of chromium, copper, manganese, tin, and zinc, were exported. Burma, with only 57% of its land geologically mapped, has potential for a wide variety of uncharted minerals. These minerals include antimony, chromium, copper, diamond, gems, gold, lead, manganese, natural gas, nickel, crude petroleum, platinum-group metals, silver, and zinc. In the Central Government, the Ministry of Mines supervises two departments. The Planning and Inspection Department is responsible for drafting the mining legislation, including mining rights, mine safety and environmental protection regulations, and special mining laws; national mineral policy; and mine inspection. The Department of Geological Survey and Mineral Exploration is in charge of the geological mapping and minerals survey and exploration except petroleum and natural gas. Exploration of petroleum and natural gas is under the jurisdiction of the Ministry of Energy.

Burma's mineral industry is composed of three State-owned metals mining enterprises, a State-owned jade and gemstones enterprise, a State-owned petroleum and gas enterprise, and many small-scale private and local enterprises. According to the Ministry of National Planning and Economic Development, the estimated employment in the mining sector was 83,000 in fiscal year 1993 or about 0.5% of Burma's estimated total employment of 16.5 million. The total output of the mining sector, in 1986 constant producers' prices, was estimated at $120 million[13] or 1.2% of Burma's gross domestic product (GDP) (the total value of net output and services), which was estimated at $10 billion for fiscal year 1993. Of the total output of the mining sector, about 73% was produced by the State-owned enterprises, 26% by the private enterprises, and 1% by cooperatives.[14]

Minerals production in Burma had been declining since the 1960's. In 1989, the Government adopted an open-door policy and a liberal foreign investment law to encourage participation of foreign mining companies in exploration and development of Burma's mineral resources. According to the Burmese Department of Geological Survey and Mineral Exploration, since 1988 no substantial foreign capital had been invested in the Burmese mining industry, especially in the nonfuel minerals sector. According to a local press report, 75 direct foreign investments were made in Burma with a total value of $956.3 million since the Government began implementing the new investment law in 1988. Of this total, only nine investments were in the mining sector.

Burma's mining industry suffered a steady decline because no new mines were developed while many of the old mines were left to deteriorate without the much needed renovation in the past years. However, because of increased contribution by the private sector, production of gemstones, gold, jade, tin, and tungsten reportedly showed some improvements in fiscal year 1993.

Burma's mineral trade involved mainly exporting jade, gems, and some amounts of copper concentrate, chromite, manganese ores, tin and tungsten concentrates, and importing some amounts of ferrous and nonferrous metals and an increasing amount of crude petroleum. Burma holds a gem emporium at the Inya Lake Hotel in Yangon (Rangoon, the national capital) in February and October annually, mainly for selling and exporting jade, gems, and jewelry. A considerable amount of high-quality jade and gems reportedly are smuggled annually to China and Thailand. Burma, once a net exporter of crude oil, imported about 4,300 bbl/d of crude petroleum and refined petroleum products in 1993 to meet its domestic demand of about 23,000 bbl/d. Australia and Malaysia were two major suppliers of crude petroleum to Burma.

Production of copper, lead, silver, and zinc was by the state-owned Mining Enterprise No. 1. Production of antimony, diamond, gold, platinum-group metals, tin, and tungsten was by the state-owned Mining Enterprise No. 2 and other small-scale private and joint Government-private mining enterprises. Production of chromite, coal, iron, manganese, nickel, steel, and industrial minerals was by the State-owned Mining Enterprise No. 3 and other small-scale private and joint Government-private mining enterprises. Production of jade and gems was by the State-owned Myanma Gems Enterprise and other private small-scale miners.

Production of copper was from the Monywa Mine, about 100 km west of Mandalay. The designed capacity of the mine and mill is 2.4 Mmt/a of ore and 60,000 mt/a of concentrate, respectively. The output of copper concentrate in the past 3 years had been below capacity owing to lack of spare parts and supplies. According to Burma's Department of Geological Survey and Mineral Exploration, the production of copper concentrate increased to 22,528 tons in fiscal year 1993 from 17,879 tons in fiscal year 1992. According to the Japanese trade statistics, exports of copper concentrate to Japan also rose from 16,671 tons in 1992 to 17,450 tons and were valued at $2.5 million in 1993.

Following a long negotiation, Mining Enterprise No. 1 reportedly had reached an agreement in 1993 with the Vancouver-based Ivanhoe Capital Corp. to establish a joint-venture company, called Ivanhoe Mayanma Holdings Ltd., to conduct feasibility study for developing a new mine and ore processing facilities for extracting copper and associated minerals at the Kysindaung-Letpadaung Taung porphyry copper deposit, about 11 km from the Monywa copper mine in

central Burma. Ore reserves in the area were estimated at 180 Mmt averaging 0.66% copper. The feasibility study was scheduled to begin in 1994.[15]

Mine production of lead, nickel speiss, silver, and zinc was from the Bawdwin (open pit) and the Namtu (underground) mines in the Shan State of northern Burma. In fiscal year 1993, the mine output of silver and zinc increased, while the mine output of lead decreased. Mining Enterprise No. 1 also operated a concentrator at Bawdwin and a lead smelter at Namtu. Mining Enterprise No. 1 had an agreement with International Minerals Co. of Singapore to form a joint venture for extracting zinc from tailings at the Namtu silver mine.

Gold production in fiscal year 1993 was estimated to be at the higher level than that of fiscal year 1992 because of the substantial contribution by the small-scale miners from the private sector. In past years, several small placer gold mines reportedly were commissioned by the Mining Enterprise No. 2 at the Phayaung Taung in Pathein near Mandalay, at the Thayet Kkone in Pyinmana, and at the Shwegyin and the Kyaukpahtoe, both in central Burma. However, the Kyaukpahtoe Mine, which was built with Yugoslavian financial and technical assistance, reportedly was still in the test stage. In 1993, the Government reportedly brought on-stream a small gold refinery at Kawlin, about 320 km north of Rangoon. Refined gold production targeted for fiscal year ending March 1994 was 260 kg.

Potential areas for gold exploration in Burma, according to the Government and industry sources,[16] are in the Kwinthonze area, about 100 km north of Mandalay; the Phayaun Taung area, about 19 km north of Mandalay; the Mangin Taung area (formerly the Wuntho Range), about 250 km north of Mandalay; and many small placer deposits, 80 km from Leshio and about 300 km northeast of Mandalay.

Despite low metal prices, production of tin and tungsten continued to increased in 1993 owing to the Government's all-out efforts in promoting participation of the private sector in setting up joint-venture firms with the Government. Most tin and tungsten were produced from the Mawchi Mine in the Kayah State. Other tin-producing areas include the Heinda, Hermingyi, and Kanbauk in the Tanintharyi mining district. The Mining Enterprise No. 2 also operated a 1,000-mt/a tin smelter in Thanlyin, near Rangoon. Owing to lack of raw material, the smelter had been operated far below its capacity. Production of refined tin mainly for domestic consumption was estimated at 200 tons.

In October, the State-owned Mining Enterprise No. 2 signed a production-sharing agreement with the Roong Siam Mining (Myanmar) of Thailand for tin exploration and exploitation off the Gulf of Martanban and the Tenassarim Coast. Roong Siam Mining was expected to conduct a 1-year exploration program in the area known to have tin deposits in the Heinze Basin.[17]

Burma also produced some amounts of chromite, nickel speiss, and manganese dioxide. But information on the annual output and the producing areas of these minerals are unkown. However, according to the Japanese and Chinese trade statistics, chromite had been exported to Japan amounting to 10,477 tons in 1989 and 6,174 tons in 1992, while manganese ore had been exported to China amounting to 2,500 tons in 1990, 59,246 tons in 1991, and 236,229 tons in 1992.

Burma produced a variety of industrial minerals in small quantities but significant amounts of precious and semiprecious stones. Production of industrial minerals, such as barite, bentonite, clays, dolomite, feldspar, gypsum, limestone, and salt, was for domestic consumption. Production of precious stones and semiprecious stones, such as diamond, jade, rubies, sapphires, and other gems was for exports. The Government through the Department of Geological Survey and Mineral Exploration reportedly was negotiating an agreement with the Stockdale Prospecting Ltd., a subsidiary of De Beers of Australia, to jointly explore for diamonds in the Mohauk area near Momeik in northeastern Burma.[18]

The State-owned Myanmar Ceramic Industries operated three cement plants. The Kyangin plant, near Mandalay, is capable of producing 270,000 mt/a of cement. The Pa-An plant, about 160 km east of Yangon, is capable of producing 280,000 mt/a. The Thayetmyo plant, 300 km northeast of Yangon, is capable of producing 270,000 mt/a. According to Government statistics, cement output declined to 400,400 tons in 1993 from 465,100 tons in 1992. A modest amount of portland cement had been imported to meet the cement shortage in some parts of the country.

The State-owned Myanmar Gems Enterprise operated gem mines at the Mogok Stone Tract for mining rubies and sapphires and at the Jade Mines area for jade. In 1993, a new gemstone mining tract was opened to the private sector at the Mongshu in eastern Burma along with two additional new gemstone mining tracts at Pyinlon and Namas in northern Burma near the Chinese border. Some good-quality rubbies and sapphires reportedly had been found in these areas. Jade mining at Nathmaw and Manshibon in northwestern burma, where high-quality jade was found, also was opened to the private sector. Myanmar Gems Enterprise held the gems emporium twice per year. One was held in February and another one in October. According to the Department of Geological Survey and Mineral Exploration, gem production continued to increase in 1993, especially for jade, which registered a tenfold increase in 1993.

Production of crude petroleum and natural gas was by Myanmar Oil and Gas Enterprise (formerly Myanmar Oil Corp.). Production of oil and gas from seven oilfields and gasfields averaged 18,630 bbl/d of crude petroleum and 3.3 Mm^3/d of natural gas, respectively, in 1993. According to the Ministry of Energy, natural gas production from the Aphyauk Gasfield in the Ayerwaddy district will be doubled from the current level to 2.2 Mm^3/d in the next few years to meet the fuel requirements of the powerplants in Ywama and Myanaung as well as the cement plants at Kyangin and Myainggale. Current production at 1.1 Mm^3/d of natural gas from the Aphyauk

Gasfield was piped to Yangon's industrial area to fuel the Sittaung Paper Mill and the powerplants at Thaketa and Shwedaung.[19] Burma's major oilfields were at Ayadaw, Chauk/Lanywa, Mann-Htaukshabin, Prome, Pyal, Shwepyitha, and Yenangyaung.

By early 1993, all of the original 10 foreign oil companies except Amoco and Yukong Oil Co. of the Republic of Korea left Burma after their 3-year contracts expired. In July, Amoco signed a 1-year extension contract for onshore blocks RSF's 3 to 6 and EP-2 in the central basin. Amoco and Yukong also signed a contract merger agreement for onshore block B and C in northern Burma. Two other U.S. companies, Apache Corp. and Santa Fe Energy Resources, both reportedly had signed a production-sharing contract with Myanma Oil and Gas Enterprise in mid-1992.

The Texaco-led consortium, which had discovered an offshore gas/condensate well, the Yetagun-1 in Block M-13 in 1992, announced in April a second successful gas/condensate well, the Yetagun East-1 in the same block in Andaman Sea, about 420 km from Yangon and 150 km off the coast. The second wildcat, Yetagun East-1, flowed a combined rate of 1.78 Mm^3/d of gas and 1,922 bbl/d of 53.5° API gravity condensate.

After signing of a production-sharing contract with Myanmar Oil and Gas Enterprise in July 1992, Total Oil Co. of France was joined by Unocal of the United States for development of the Yadana gas well in the Andaman Sea, about 112 km off the coastal town of Bogale. The Yedagun-1 well at Yadana, which was discovered by Japex in the early 1980's, yielded 2 Mm^3/d of natural gas. The Yedagun-2 well, about 192 km west of Myeik (Mergui), reportedly also hit oil and gas. According to preliminary tests, the well has a potential yield of 2,800 bbl/d of petroleum and 2.5 Mm^3/d of natural gas. Thailand and Japan reportedly had expressed interested in purchasing natural gas from the Yadana Field.

The State-owned Myanmar Petrochemical Enterprise operated two oil refineries, a 6,000-bbl/d capacity at Chauk and a 26,000-bbl/d capacity at Thanlyn. To meet the domestic demand for refined petroleum products, Burma reportedly imported considerable amounts of crude petroleum principally from Australia and Malaysia to supplement the domestic shortfall because of the low level of domestic output.

TABLE 5
BURMA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991[p]	1992[e]	1993[e]	Annual capacity[e] (Jan. 1, 1994)
METALS							
Chromium: Chromite, gross weight[e]		5,000	1,000	1,000	6,200	1,000	7,000
Copper:							
Mine output, Cu content		5,080	4,399	5,670	r5,534	6,980	7,000
Matte, gross weight		200	53	150	150	100	
Gold, mine output[e]	kilograms	126	150	130	140	200	250
Iron and steel: Pig iron		2,946	406	e1,000	500	500	3,000
Lead:							
Mine output, Pb content		5,200	e4,400	e4,700	4,800	3,000	6,000
Metal:							
Refined		3,443	2,750	2,177	2,112	14,000	4,500
Antimonial lead (93% Pb)		300	88	e100	100	80	
Manganese mine output, Mn content[e]		47	55	50	50	50	100
Nickel							
Mine output, Ni content[e]		20	50	20	20	20	50
Speiss, gross weight		184	163	50	100	50	
Silver, mine output	kilograms	5,910	5,816	5,256	4,790	5,000	10,000
Tin, mine output, Sn content:							
Of tin concentrate		172	190	114	130	100	200
Of tin-tungsten concentrate		329	463	404	580	400	600
Total		501	653	518	710	500	800
Metal: Refined		171	275	157	189	150	300

See footnotes at end of table.

TABLE 5—Continued

BURMA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991[p]	1992[e]	1993[e]	Annual capacity[e] (Jan. 1, 1994)
METALS—Continued							
Tungsten, mine output, W content:							
Of tungsten concentrate		8	9	5	25	20	30
Of tin-tungsten concentrate		225	342	270	350	250	320
Total		233	351	275	375	270	350
Zinc, mine output, Zn content		1,400	1,559	1,750	1,880	1,900	2,000
INDUSTRIAL MINERALS							
Barite[3]		11,278	9,468	r11,339	r13,589	10,000	15,000
Cement, hydraulic		394,000	420,000	435,189	465,125	400,391	500,000
Clays:[3]							
Ball clay		203	100	200	150	150	300
Bentonite		711	416	e600	200	300	800
Fire clay[4]		3,150	1,404	2,540	2,500	2,500	3,500
Industrial white clay		—	779	—	—	—	—
Feldspar[3]		4,257	2,476	e2,500	2,600	2,600	5,000
Graphite[3]		—	45	36	—	—	—
Gypsum[3]		31,534	32,952	33,630	36,070	35,000	37,000
Nitrogen: N content of fertilizer		120,000	r77,400	r111,000	130,000	130,000	130,000
Precious and semiprecious stones:							
Jade[3]	kilograms	660,200	242,200	177,900	145,800	150,000	200,000
Salt, all types:[5]	thousand tons	262	—	260	260	260	270
Stone:[3]							
Dolomite		1,930	3,505	2,792	1,016	1,000	3,500
Limestone, crushed and broken	thousand tons	1,219	1,320	1,860	1,700	1,500	3,000
MINERAL FUELS AND RELATED MATERIALS							
Coal, lignite		37,594	30,815	56,690	56,000	56,000	60,000
Gas, natural:							
Gross[e]		1,133	1,015	934	r1,133	1,200	1,200
Marketed[3]		1,088	993	817	r1,015	1,140	1,150
Petroleum:							
Crude (gross wellhead)[3]	thousand 42-gallon barrels	5,600	5,800	5,372	r5,609	5,400	5,800
Refinery products[e 3]	do.	3,287	3,200	3,800	3,500	3,000	4,000

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Table includes data available through Mar. 15, 1994.

[2]In addition to the commodities listed, pottery clay, common sand, glass sand, other varieties of crude construction stone, and other varieties of gemstones are produced, but available information is inadequate to make reliable estimates of output levels.

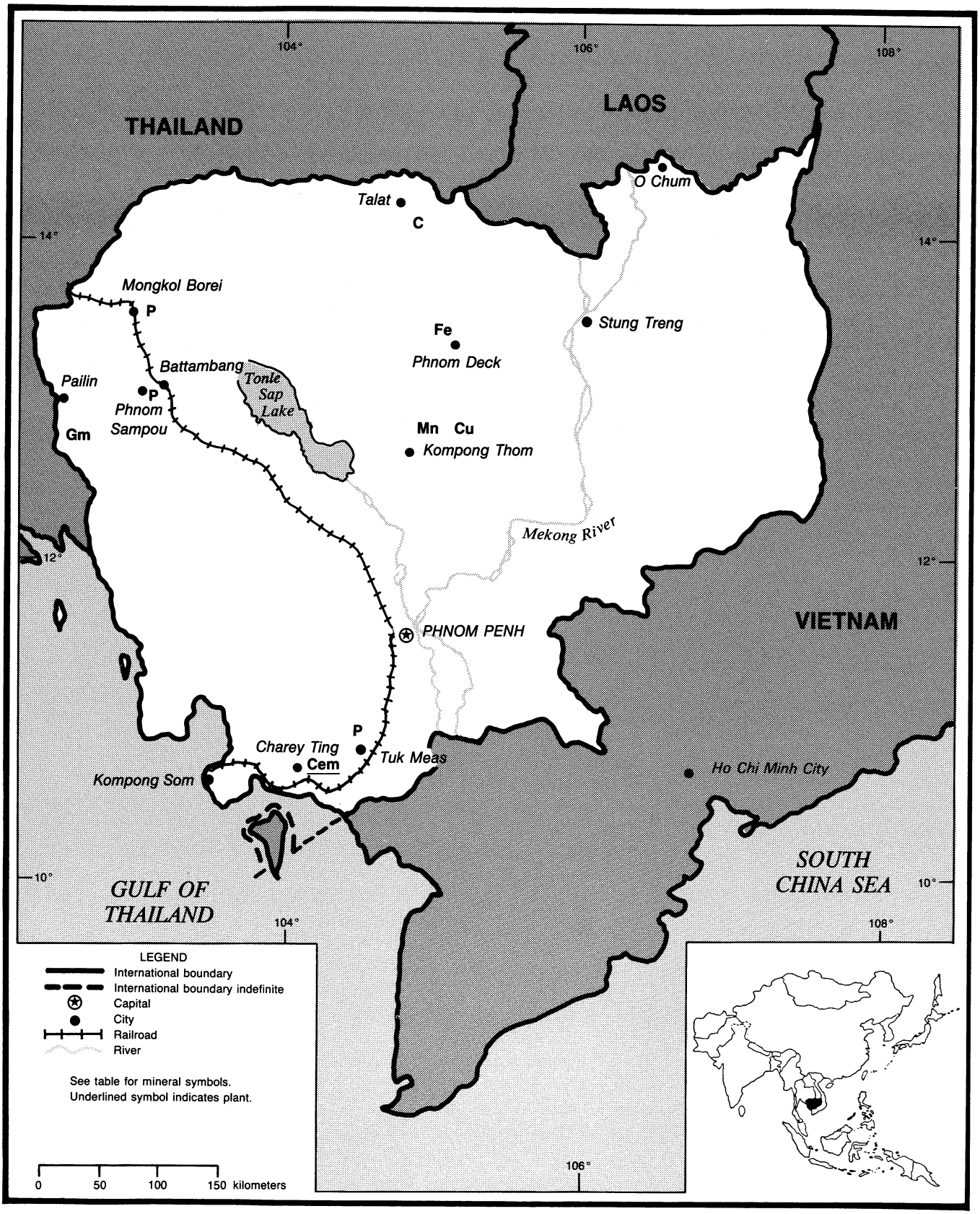
[3]Data are for fiscal years beginning Apr. 1 of that stated.

[4]Includes fireclay powder.

[5]Brine salt production (in metric tons), as reported by the Burmese Government, was as follows: 1989—60,229; 1990—49,670; 1991—46,835; 1992—46,509; and 1993—59,015.

CAMBODIA

AREA 181,040 km² **POPULATION 7.3 million**



CAMBODIA[20]

The peace process that was set in motion in 1991 with the United Nations-sponsored Paris peace accord resulted in May in the formation of a legitimate coalition Government. However, the country remained isolated from the mainstream of world trade owing to the lack of resources, both natural and human, and the country continued to suffer serious economic difficulties. Inflation remained rampant during the year after averaging about 180% in 1992.

The minerals industry, as most other sectors of the economy, remained stagnant. Essentially, construction materials (brick clays, gravel, and stone), gemstones (ruby and sapphire), phosphate rock (apatite), and salt were the only mineral commodities produced and consumed domestically. No Cambodian mineral commodities were known to have been exported legally. However, gemstones may have been smuggled out of the country. Mineral imports included petroleum products and clinker for cement manufacture.

Cambodia's mineral industry is distributed erratically and operated irregularly. One small plant of unknown capacity was thought to produce cement intermittently at Charey Ting, about 70 km southwest of Phnom Penh. Highly localized utilization of clays for making brick represented an industry of sorts. The technology used was simple and widely applied in many districts and Provinces.

Cambodia has gem-quality corundum mineralization in several parts of the country, ranging from Pailin near the western border with Thailand to the eastern border area between Stung Treng in Cambodia and Pleiku in Vietnam. High-quality rubies have been found, but cornflower-blue sapphire has been the most valuable gemstone produced in Cambodia.

A phosphate plant at Tuk Meas, Kampot Province, was essentially a grinding and roasting operation for locally dug apatite. The treatment enhanced the solubility of the contained phosphate for application as fertilizer. Little information was available on salt production, which was from numerous small operations. Estimated production for the past several years was about 40,000 mt/a.

Additional information on the mineral resources of Cambodia is scant. The country is known to have coal, copper, iron, and manganese deposits, but their quality and quantity have not yet been determined. Reportedly, the country also has deposits of gold, lead, and zinc to the east and northeast of Stung Treng, but the prospects discovered years ago never have been evaluated. The Cambodia Petroleum Exploration Co., a joint venture comprised of the Japanese firms Japan Petroleum Exploration Co. and Nissho Iwai Corp., has been exploring since 1991 for petroleum off Kompong Som in the Gulf of Thailand, but nothing commercially viable has been reported.

Essential elements of the communications-transportation infrastructure include 13,351 km of roads, including 2,622 km with bituminous pavement; 7,105 km of crushed stone, gravel, or other loose surface; and 3,624 km of unimproved earth or dirt track. Many of the roads are in disrepair, both from neglect and the results of 23 years of war. Inland waterways included 3,700 km navigable all year to craft drawing 0.6 m and 282 km navigable part of the year to craft drawing 1.8 m. The Government-owned railway consists of 612 km of 1-m-gauge track. Its operating condition is uncertain. There were five principal airports with permanent-surface runways out of an aggregate of nine in operating condition in the country. Two had runways 2,440 to 3,659 m in length, and four had runways 1,220 to 2,439 m long. Principal ports were Kompong Som on the coast of the Gulf of Thailand, and Phnom Penh, inland on the Mekong River. Cambodia had an electric power generating capacity of 35 MW and produced power at the approximate level of 9 kW • h per capita.[21]

OTHER SOURCES OF INFORMATION

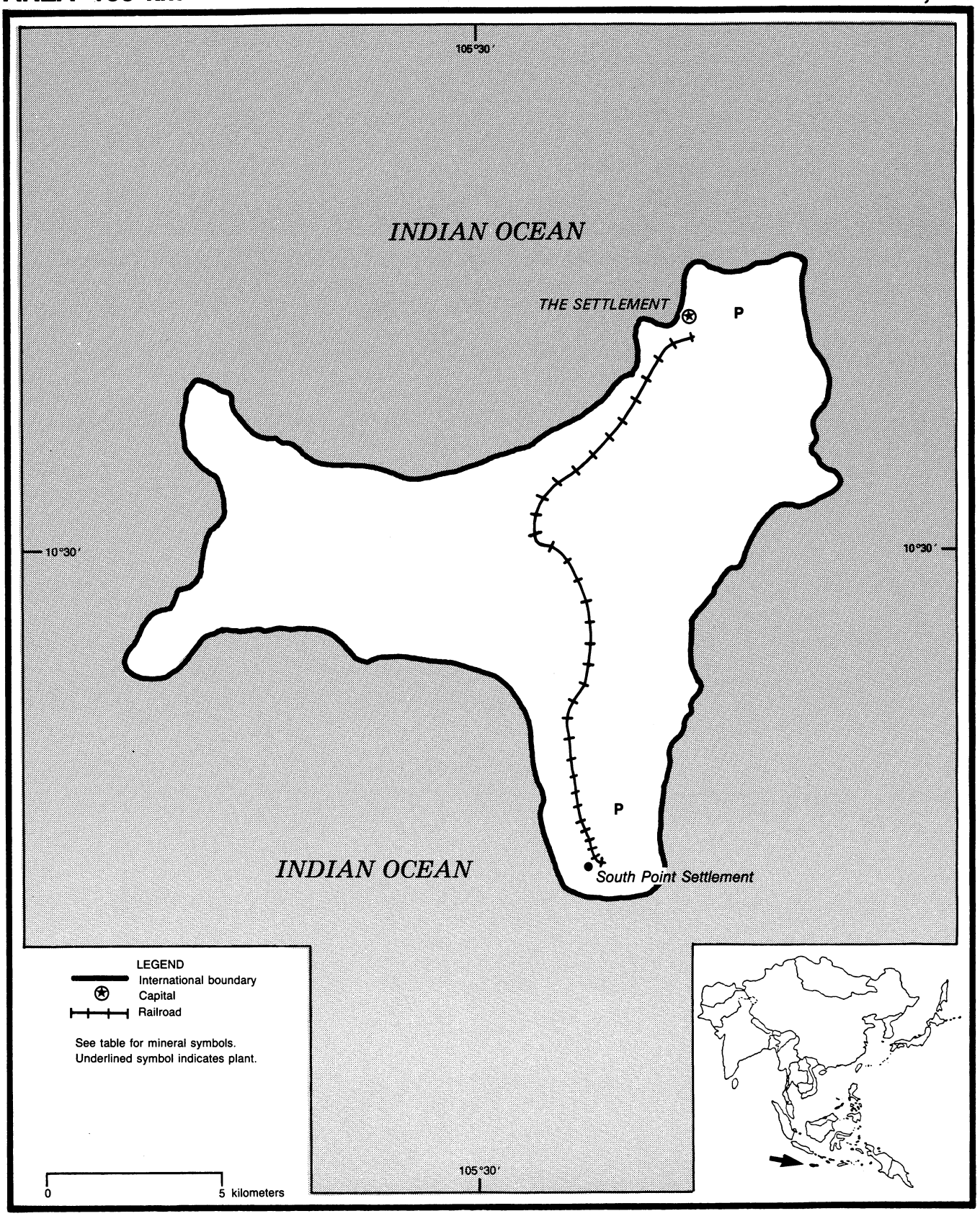
Agency

Ministry of Industry, Mines, and Energy
Phnom Penh, Cambodia

TERRITORY OF CHRISTMAS ISLAND

(Australia)

AREA 135 km² **POPULATION 1,000**



CHRISTMAS ISLAND[22]

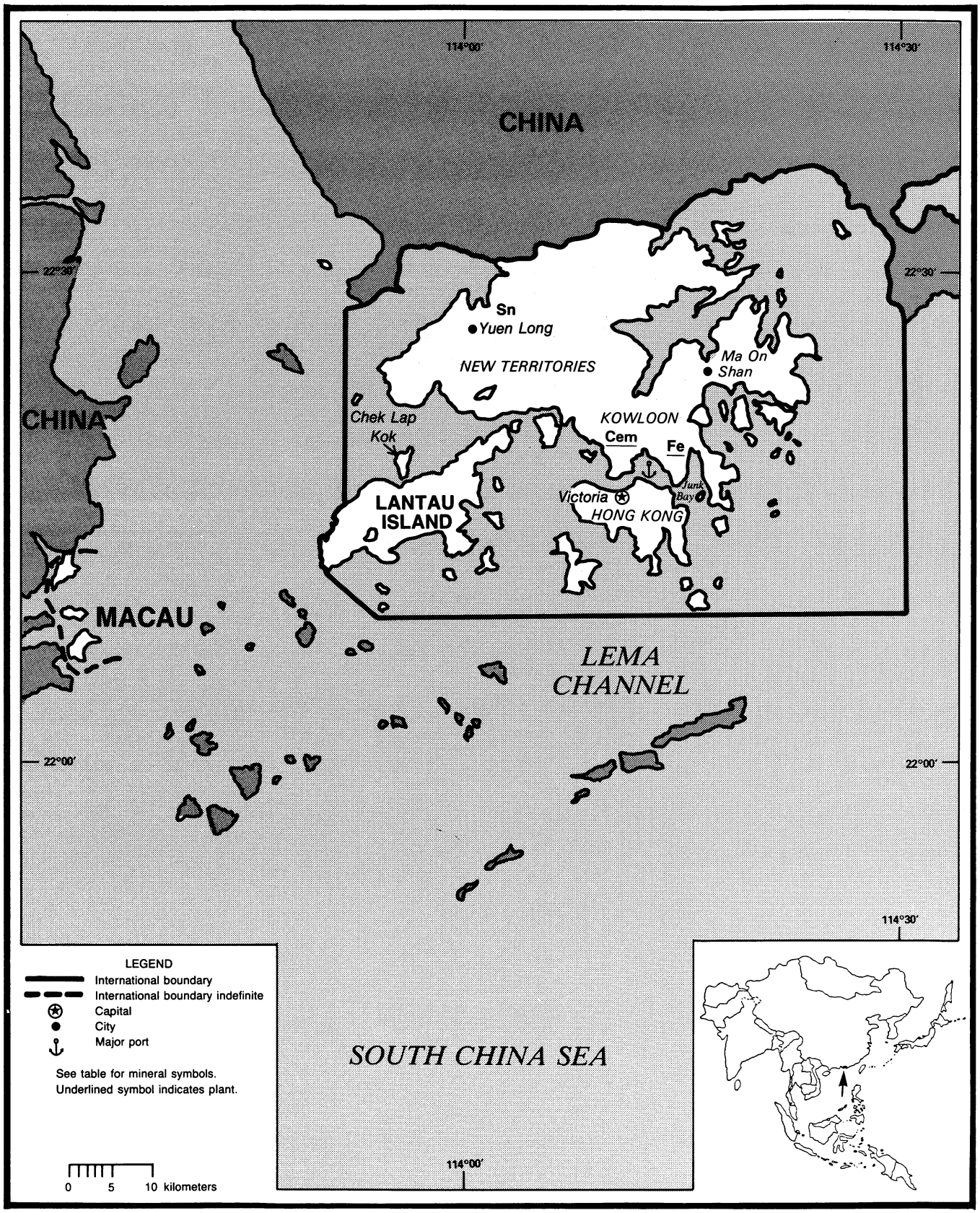
From 1897 until mining ceased in 1987, guano-based phosphate rock was the mainstay of the economy of the Territory of Christmas Island, an island territory of Australia in the Indian Ocean. The mining operation, owned by the Phosphate Mining Co. of Christmas Island, a wholly Australian Government-owned firm headquartered in Perth, was closed primarily because of the exhaustion of high-grade phosphate reserves. The area where high-grade phosphate reserves remain has been classified as a national park to preserve the few remaining tall trees in the rain forest and, therefore, the natural habitat for the rare bird species on the island. Resources of lower grade phosphate rock containing 74% to 76% bone phosphate of lime are minable in less sensitive parts of the island.

In 1991, the Australian Government contracted Phosphate Resources NL to renew phosphate mining on the island, but no mining has occurred since December 1987. Phosphate Resources was owned by Clough Engineering Ltd., 51%; the citizens of Christmas Island, 40%; and Saley Investments Pty., 9%.

There is one permanent-surface airport on the island and one shipping port, Flying Fish Cove. Christmas Island had an electric power generating capacity of 11 MW and produced power at the approximate level of 17,800 kW • h per capita.[23]

HONG KONG AND MACAU

AREA 1,040 km² **POPULATION 6.4 million**



HONG KONG AND MACAU[24]

Both Hong Kong and Macau have limited natural resources. More than 80% of the consumer goods, raw materaial, and semimanufactured products are imports. Unlike the United States, the Hong Kong Government produced a budget surplus of $1.9 billion[25] in 1993. The Financial Secretary of Hong Kong decided to reduce the corporate tax rate by 1% to 16.5% and increase the basic allowances for personal income tax in 1994. At the same time, the Financial Seccretary proposed increasing property rates, doubling the business registration fee, and curbing tax-avoidance schemes. These reflect the strength of Hong Kong's economy. In 1993, the real economic growth was 5.5% and the inflation rate slowed down to 8.5%. The exports and imports trades only grew by 13% and 12%, respectively, in 1993. Also, Hong Kong continued registrating a trade deficit, $3.8 billion in 1993.

China's National People's Congress ratified the Basic Law that would regulate the post-1999 Macau Special Administration Region when China resumes sovereignty over Macau from Portugal on December 20, 1999.

According to Hong Kong's Government statistical information, Hong Kong's industrial production and employment in the manufacturing sector continued shrinking in 1993. Production of metals and semimanufactural metal products was down by 9.4%. However, employment in finance, insurance, real estate, and business services grew by 7.5%.

The Mines and Quarries Div. of the Geotechnical Engineering Office of the Civil Engineering Department oversees activities relating to mining, quarrying, and explosives in Hong Kong. Hong Kong consumed 1.7 Mmt of sand, aggregates, and other rock products in 1993. Local suppliers provided about one-half of them, and the balance was imported from China.

Because of depression of the tin market and financial trouble, the Mainland Metals and Minerals in Hong Kong was forced to shut down. The 600 mt/d tin smelter was taken over by a group of five creditors in early 1993. However, the financial problems continued. The creditors lost confidence in Mainland Metals and Mineral and decided to sell off Mainland's assets.

Because the Hong Kong authorities redesigned its city plan, Shiu Wing Steel Work was forced to relocate its steel plant from Junk Bay to Tuen Mun in Hong Kong. Shiu Wing Steel Work is a family owned company with a monthly output capacity of 30,000 tons of rebars with two electric arc furnaces. Shiu Wing Steel Work planned to take advantage of the relocation to redesign its plant layout and add new equipment. The company hoped to add a new rolling mill that would have a capacity to produce 8 mm diameter steel bar. Shiu Wing expected the new plant to begin operation in early 1996.

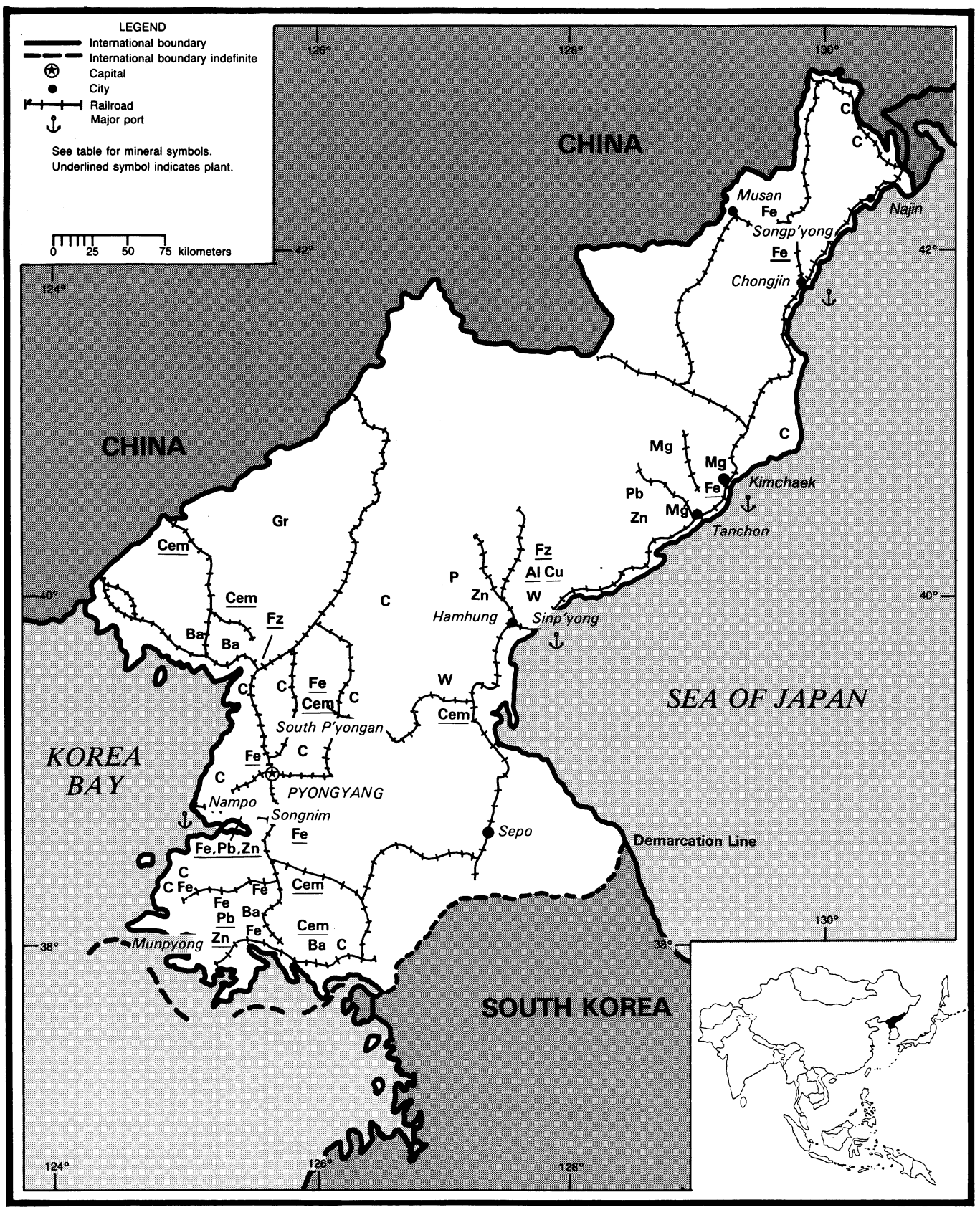
Shoudu Iron and Steel Corp. (Shougang) of China wanted to use Hong Kong as a base for expansion of its interests in Southeast Asia in the 1990's. In 1993, Shougang teamed up with its Hong Kong partners to acquire several listing companies in Hong Kong. This is one of many of China's state-owned enterprises to penetrate into Hong Kong's business environment before 1997.

In the 1980's, multinational chemical companies such as BP, Dow, ICI, and Philips Petroleum International set up regional headquarters in Hong Kong. These companies believed that Hong Kong is a strategic location for providing financial, marketing, and trading services to China's and Southeast Asian countries' chemical sectors. However, the rising cost of office space, apartments, and labors has diminished its attractivness for companies to set regional headquarter in Hong Kong in the 1990's. Also, many companies worried about the political uncertainty when China resumes sovereignty over Hong Kong from the United Kingdom on July 1, 1997.

Hong Kong has six major regulations to control pollution: the Waste Disposal Ordinance; the Water Pollution Control Ordinance; the Air Pollution Control Ordinance; the Noise Control Ordinance; the Ozone Layer Protection Ordinance; and the Dumping At Sea Act Order. The objectives were to protect public health and preserve the natural ecosystem in Hong Kong.

NORTH KOREA

AREA 120,540 km² **POPULATION 22.6 million**



NORTH KOREA[26]

The country's economy deteriorated and the gross domestic product (GDP) was reported to shrink again in 1993. Military expenditures took up more than 20% of the nation's GDP. North Korean industry was operating at 50% of its capacity because of chronic power shortages. Lack of fuel and raw materials for the industry was common. The industrial production declined considerably, notably cement, chemical fertilizer, coal, nonferrous metals, steel, textiles, and vehicles.

The country found it increasingly difficult to sell its poor quality products abroad. Furthermore, falling output of key export commodities compounded the problems in raising hard currency and reduced the ability to secure imports. Shortages of fertilizer and pesticides for agriculture also were experienced. Combined with poor weather and bad management, agricultural output fell by as much as 30%.

In the past, the country depended on streams of heavily subsidized foreign trade with Russia and China. This was no longer true. North Korea imported $200 million[27] worth of grain during 10 months of the year, including $74 million worth from China. The Chinese insisted that a cash payment system replace the previous barter arrangements. Oil imports were decreasing too. The country used to depend primarily on China for crude oil. Other suppliers included Iran, Libya, and Russia. During the first half of the year, North Korea imported $185 million worth of crude oil and coal from Russia. Low-priced Russian oil began to be sold in North Korea near yearend. North Korea was reported to have a contract with Iran to exchange missiles for 1 Mmt/a of oil, which represented 40% of the country's oil imports. South Korean traders' overseas branches were asked by North Korea for assistance in buying crude oil from third countries in exchange for minerals and steel. Inter-Korean trade increased during the year. Purchases by South Korea included construction materials, billet, gold ingots, and zinc ingots.

The Government promulgated a liberal foreign investment law and offered tax incentives for joint ventures. It would allow operations by foreign banks. The Foreign Enterprise Law provided a legal framework for wholly owned foreign companies to be established and operated within proclaimed free economic and trade zones. Government officials discussed bilateral mining industry cooperation with Cambodian Government officials. Overseas representatives were contacting multinational firms for investments and searching for new supplies of food and crude oil. The annual flow of money estimated at $600 to $700 million from North Korean nationals in Japan could total 3% of North Korea's yearly budget, which was estimated to be $18 billion. Furthermore, employment of North Koreans in Siberia-based factories and labor camps increased substantially.

It was reported that North Korea was trying to attract foreign investment for an oil refinery in its Najin-Sonbong special free trade zone. In the free trade zone, foreign investment projects also included the construction of transportation, powerplants, and processing industries. Foreigners would not need visas if they entered the free trade zone on designated routes. The Government agreed to let foreign companies lease land in the free trade zone.

The Musan mining complex produced more than 10 Mmt of iron ore in 1993. Iron ore was concentrated and transported in slurry form by pipeline to the nearby Kimchaek iron and steel complex. Iron and steel output was increased at the Hwanghae iron and steel complex.

Cement production continued to be at about the same level as last year's. The Sunchon and Sangwon cement complexes are the two largest producers in the country and their capacities were rated at 3 Mmt/a and 2 Mmt/a, respectively. Indigenous strata of limestone for cement were found in most areas in South Pyongan Province.

Large deposits of diatom earth were found in the Provinces of Kangwon, North Hwanghae, and South Hamgyong. A joint-venture company between North Korea and Japan was established at Myongsim to produce graphite of high purity. Graphite occurs in a geologic setting across the Korean peninsula.

The construction of a crushing and processing plant was completed at the Taedaeri phosphate mine in west-central North Korea. These facilities were to enable the operation to increase its ore handling capacity by 20%. A salt production base with a capacity of 100,000 mt/a was being constructed at Hamhung, South Hamgyong Province. The production processes were to be mechanized, automated, and computer-controlled.

Facility upgrades were being carried out at the Hwapung coal mine in Anju District, 50 km north of Pyongyang. New coal mines and pits were under construction with mining equipment operated at full capacity in the district. A long-distance belt conveyor was being constructed at the Namyang Mine in Pukchang coal district. Both coal districts are in South Pyongan Province. A high-quality coal deposit estimated at more than 1 Mmt was found in a district in Hwanghae Province. The coal in the district was bituminous and contained much humid acid. In North Hamgyong Province, rich coal deposits also were discovered.

The country's infrastructure development was minimal. However, increased fund appropriations for the development of rail transport on major trunk lines were placed in electrification and heavy rails. The Government planned to increase freight rail transport by electric locomotives to 90%. The Pukchang thermal powerplant was operated at full capacity and yet did not produce enough electricity for local use. The country's electric power output amounted to 7,200 MW in 1993.

TABLE 6

NORTH KOREA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
METALS							
Aluminum metal ingot, primary		10,000	—	—	—	—	—
Cadmium metal, smelter		100	100	100	100	100	—
Copper:							
Mine output, Cu content		12,000	15,000	15,000	16,000	16,000	—
Metal:							
Smelter:							
Primary		25,000	25,000	20,000	21,000	23,000	—
Secondary		5,000	5,000	5,000	5,000	5,000	—
Total		30,000	30,000	25,000	26,000	28,000	—
Refined:							
Primary		25,000	25,000	19,000	20,000	22,000	—
Secondary		10,000	10,000	5,000	5,000	5,000	—
Total		35,000	35,000	24,000	25,000	27,000	—
Gold, mine output, Au content	kilograms	5,000	5,000	5,000	5,000	5,000	—
Iron and steel:							
Iron ore and concentrate, marketable:							
Gross weight	thousand tons	9,500	10,000	10,000	10,500	10,500	13,000
Fe content	do.	4,400	4,700	4,700	4,900	4,900	—
Metal:							
Pig iron	do.	6,500	6,500	6,500	6,600	6,600	—
Ferroalloys, furnace type unspecified	do.	120	120	120	120	120	—
Steel, crude	do.	7,300	8,000	8,000	8,100	8,100	8,500
Lead:							
Mine output, Pb content		80,000	80,000	80,000	75,000	80,000	—
Metal:							
Smelter, primary only		65,000	65,000	70,000	65,000	70,000	—
Refined:							
Primary		70,000	70,000	75,000	70,000	75,000	—
Secondary		5,000	6,000	5,000	5,000	5,000	—
Total		75,000	76,000	80,000	75,000	80,000	85,000
Silver, mine output, Ag content	kilograms	50	50	50	50	50	—
Tungsten, mine output, W content		500	1,000	1,000	1,000	1,000	2,000
Zinc:							
Mine output, Zn content		230,000	230,000	200,000	200,000	210,000	—
Metal, primary		210,000	200,000	175,000	175,000	200,000	—
Barite		100,000	100,000	100,000	100,000	110,000	—
Cement, hydraulic	thousand tons	16,000	16,000	16,000	17,000	17,000	—
Fluorspar		40,000	40,000	41,000	41,000	41,000	—
Graphite		35,000	35,000	35,000	38,000	38,000	50,000
Magnesite, crude	thousand tons	1,500	1,500	1,600	1,600	1,600	1,800
Nitrogen, N content of ammonia	do.	500	500	550	550	600	—
Phosphate rock		500,000	500,000	500,00‘	500,000	510,000	—
Salt, all types		570,000	580,000	580,000	590,000	590,000	—
Sulfur	thousand tons	230	230	240	240	240	—
Talc, soapstone, pyrophyllite		100,000	170,000	170,000	170,000	180,000	—

See footnotes at end of table.

TABLE 6—Conitnued

NORTH KOREA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

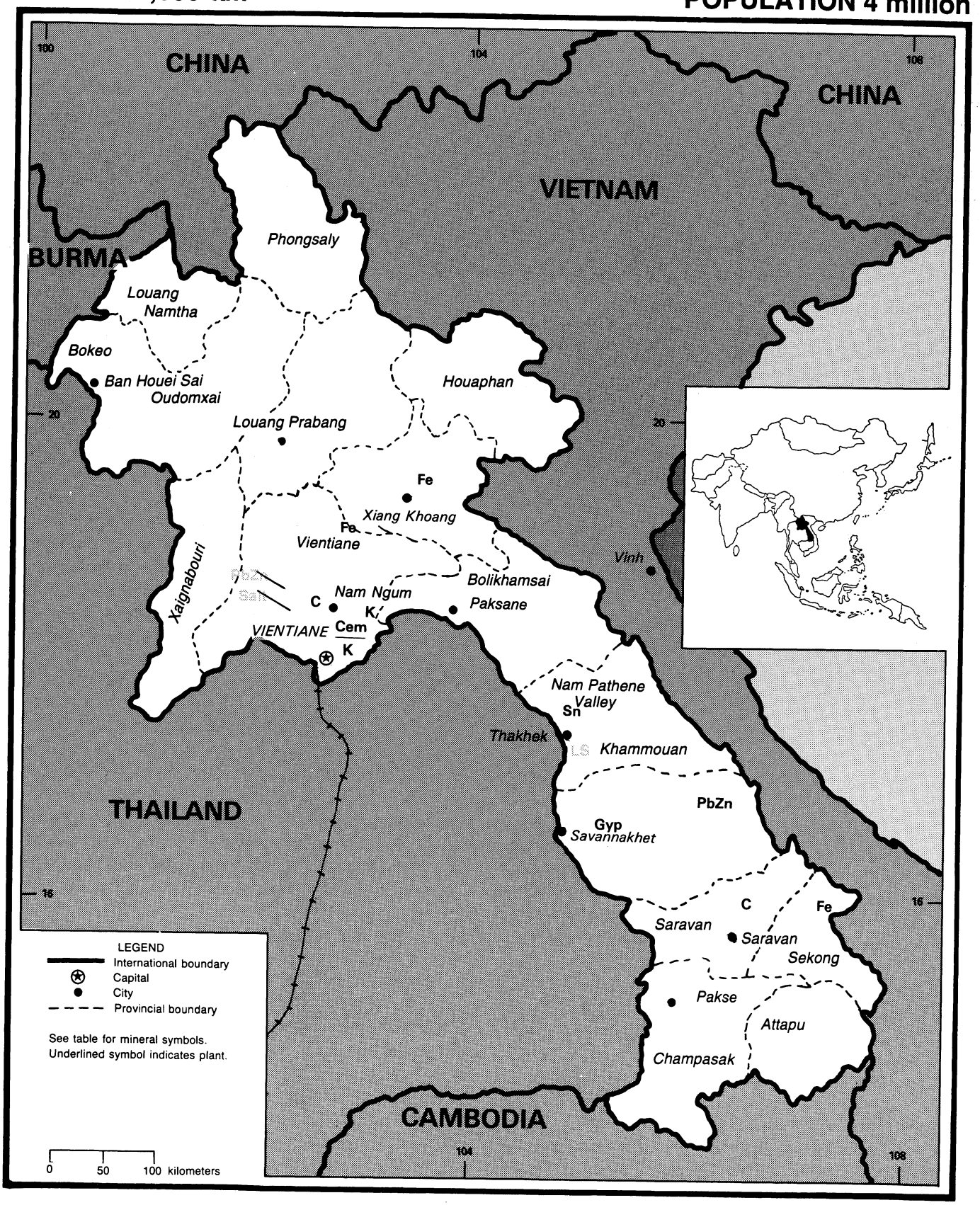
Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
MINERAL FUELS AND RELATED MATERIALS							
Coal:							
Anthracite	thousand tons	65,000	68,000	70,000	70,000	71,000	75,000
Lignite	do.	20,000	22,000	20,000	21,000	21,000	—
Total	do.	85,000	90,000	90,000	91,000	92,000	—
Coke	do.	3,000	3,000	3,000	3,000	3,000	—
Petroleum refinery products:							
Gasoline	thousand 42-gallon barrels	8,300	8,500	8,400	8,500	8,600	—
Jet fuel and kerosene	do.	1,800	1,800	1,700	1,800	1,800	—
Distillate fuel oil	do.	7,700	7,800	7,600	7,800	7,800	—
Residual fuel oil	do.	4,200	4,200	4,100	4,200	4,300	—
Refinery fuel and other products	do.	2,200	2,200	2,200	2,300	2,400	—
Total	do.	24,200	24,500	24,000	24,600	24,900	—

[1]Table includes data available through July 29, 1994.

[2]In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

LAOS

AREA 236,800 km² **POPULATION 4 million**



LAOS[28]

The Lao People's Democratic Republic is a tiny landlocked country on the Indochinese Peninsula. The economy is small, undiversified, and dominantly agrarian; it is based primarily on wet rice farming and slash-and-burn cultivation. The mining and quarrying sector of the economy is virtually negligible.

The mineral resources of Laos include coal, copper, gold, gypsum, iron ore, lead and zinc, rock salt, sapphire, tin, and, probably, petroleum. The only significant mineral production in the country until recently has been tin ore. Some of the other mineral resources have been extracted, but only by using primitive and unsystematic methods. In addition, limestone has been quarried near Thakhek in Khammouan Province and used locally for highway construction; some also has been exported to Thailand. Other construction materials such as sand and gravel also have been extracted on a small scale, mainly from the renewable deposits of the Mekong River, which constitutes most of the country's western boundary with Thailand. Essentially, the current mineral industry of Laos is unstructured, sporadic, and minor.

Gold is found throughout Laos in deposits occurring in primary quartz veins, in association with base metals, and in placers. Current production is obtained by panning at numerous sites in both the north and the south of the country.

Laos' iron ore deposits are in Xiang Khoang Province, in the north-central part of the country. The principal deposits are Pha Lek and Phou Nhouan, both of which are deemed to have economic potential. However, they remain basically undisturbed owing to inaccessibility, lack of infrastructure, and the high capital cost required for development.

Tin mining continues to be a cottage industry from a group of small mines in the Nam (River) Pathene Valley about 60 km north of Thakhek. The principal ore is a surface enrichment of cassiterite, an oxide of tin.

Production of gypsum comes from Savannakhet Province and is marketed to customers across the border in Vietnam. The mine and plant originally were developed in the late 1970's by the Vietnamese. Production characteristically is suspended during the rainy season, which typically occurs from June to October, although stockpiled material sometimes is processed during this period. The gypsum underlies potash and rock salt horizons in a thick and extensive evaporite sequence. High-grade rock salt is also mined from these evaporite deposits. However, mining methods and marketing patterns of product are unknown.

Sapphire is mined, or collected, on an artisanal scale by the local population from placer deposits near Ban Houei Sai, Bokeo Province, in the northwest and from streambeds throughout the southern part of the country.

Coal reportedly has been mined since about 1985 at the rate of about 1,500 mt/a from deposits at Bochan, northwest of Vientiane in Vientiane Province. Coal also occurs in the south of the country in Saravan Province and in the north of the country in Phongsaly Province.

Laos is one of the world's poorest countries. Its infrastructure is primitive at best, having no railroads (although a Thai railroad reaches Nong Khai, across the Mekong from Vientiane, which serves as a main trade artery for the country) and only a rudimentary transportation system. There are almost 27,530 km of roads, of which about 1,855 km is paved. Another 7,450 km consists of gravel, crushed stone, or other types of improved surface. The remaining 18,225 km or so of road is unimproved loose surface, often impassable during the rainy season.

The country has almost 4,590 km of inland waterways, primarily the Mekong River and its tributaries. An additional 2,900 km is navigable by craft drawing less than 0.5 m.

The country has one 136-km pipeline for petroleum refinery products that is thought to be in the process of being extended from Vientiane to Vinh, Vietnam.

There are 54 airports in the country, 41 of which are considered usable. There are only eight airports with paved runways. There are no airports with runways more than 3,659 m in length and only one airport with a runway longer than 2,440 m. Only one airport, the Wattay International in Vientiane, has regularly scheduled flights.

Laos had an electric power generating capacity of 226 MW and produced power at the approximate level of 220 kW•h per capita.[29]

TABLE 7

LAOS: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Cement (from imported clinker)		[3]6,875	6,500	7,000	7,000	7,000	7,000
Gemstones (sapphires)	carats	[3]37,925	30,000	35,000	35,000	35,000	38,000
Gypsum[3]		104,000	53,034	76,776	79,863	80,000	130,000
Salt, rock		[3]7,950	8,000	8,000	8,000	8,000	30,000
Tin, mine output, Sn content		[3]127	[3]500	300	300	300	550

[e]Estimated.

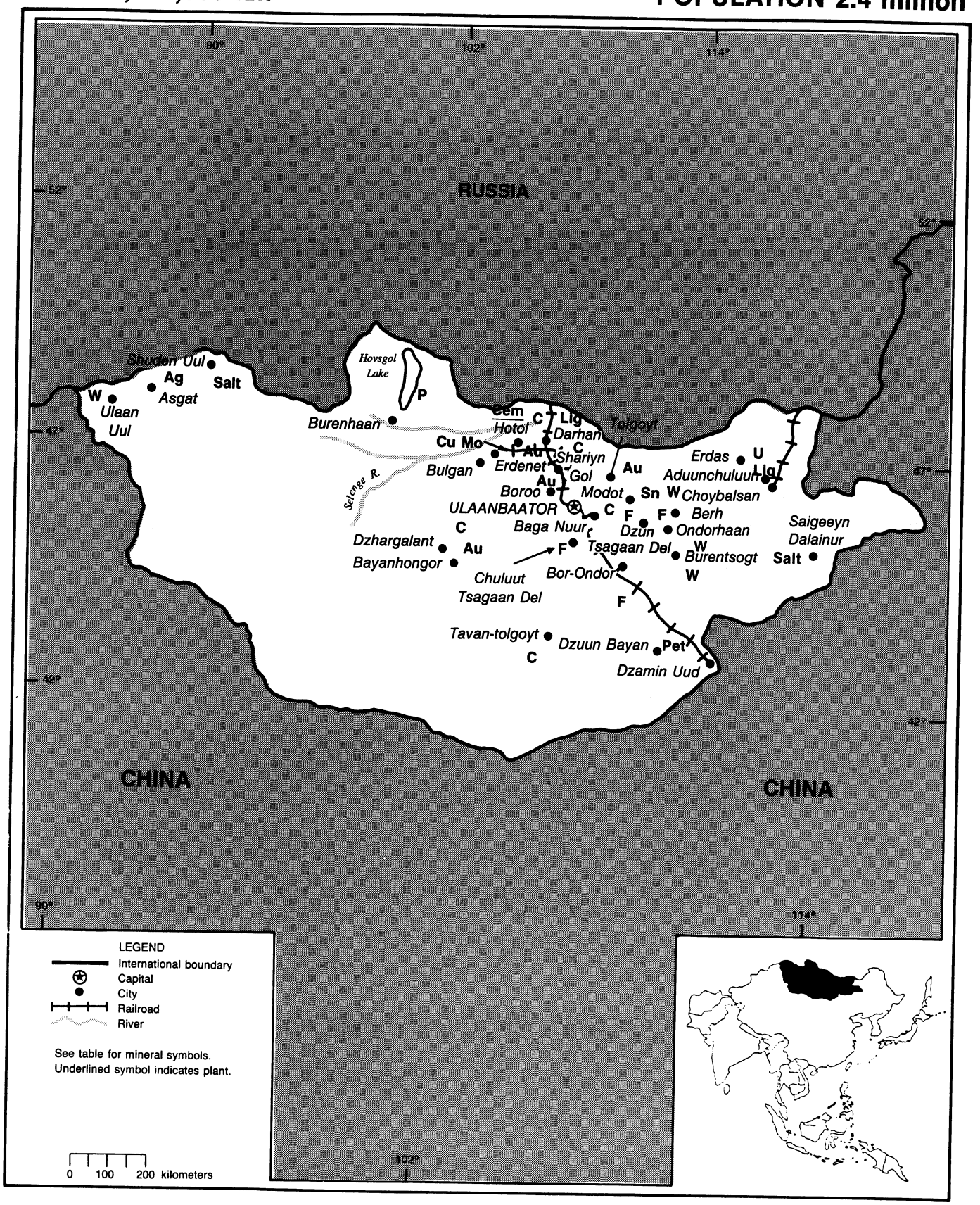
[1]Table includes data available through July 11, 1994.

[2]In addition to the commodities listed, crude construction materials such as sand and gravel and varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

[3]Reported figure.

MONGOLIA

AREA 1,565,000 km² **POPULATION 2.4 million**



MONGOLIA[30]

Mongolia is a mineral-rich country. According to the Ministry of Geology and Mineral Resources (MGMR) of Mongolia, more than 6,000 occurrences of about 80 different minerals had been found in Mongolia. Of these findings, about 500 deposits of 40 different minerals had been evaluated and about 150 deposits were being worked. Currently, coal, copper, fluorspar, and molybdenum are mined by large-scale operations, while other ore deposits, such as clays, gold, gypsum, limestone, silver, precious stones, tin, and tungsten, were mined by medium- and small-scale operations. Most of these mining operations were in the north-central and eastern parts of the country.

Since the 1980's, uranium reportedly was being mined in the northeastern part of the country by Russia under a long-term lease agreement. Recently, a wide variety of minerals, including placer and hard-rock gold, petroleum, polymetallic minerals, rare earths, and uranium, and industrial minerals, such as clays, magnesite, silica sand, and zeolite, in central and eastern Mongolia reportedly were ready for joint exploration and development with foreign investors.

Mongolia's minerals output was estimated to account for 19% of its gross industrial production, and its minerals exports were estimated to account for about 60% of its total export earnings, which amounted to $360.9 million[31] in 1993. According to the Mongolian State Statistical Office, the Mongolian economy continued its 3-year downward trend and contracted by a further 8.1% in 1993. A further reduction in raw materials supplies, such as intermediate goods and spare parts, from Russia for the production of manufactured goods as well as a sharp decline in cattle breeding due to an unusually cold spring were cited by the Government as the two principal causes of the decline in the Mongolian economy in 1993. However, according to an estimate by the World Bank, Mongolia's gross domestic product (GDP) declined only by 1% in 1993. According to the World Bank, the larger decline in GDP as estimated by the Mongolian Government was due to a lower estimate of GDP contribution by the growing private sector.

Industrial production, which accounted for about 35% of the country's GDP, fell by 13% in 1993, while Mongolia's unemployment rate rose to 8% from 5.5% in 1992. The overall two-way merchandise trade also declined by 10.5% to $722.4 million, with export earnings of $360.9 million and imports of $361.5 million in 1993.[32] To unify the exchange rate for official free market transactions, a free exchange rate was introduced by the Government on May 28, 1993. According to quotations of the Mongolian Central Bank, the exchange rates fluctuated between 390 Tugriks and 400 Tugriks to 1 U.S. dollar during the second half of 1993.

To end the economic downturn and to create the foundation for the economic reconstruction, a Program of Action was proposed by the Government to the State Great Hural (Parliament) in 1993 for discussion and approval. According to the Ministry of Trade and Industry, the country's industry reconstruction policy, under the new program, would focus on the development of gold mines to increase gold exports and using foreign currency earned from the gold exports for the development of oilfields.[33]

To assist economic development in Mongolia, in August, the Asian Development Bank (ADB) approved a $30 million interest-free loan to be repaid in 40 years. The loan, which includes an extra 1-million grant and ADB technical assistance, would be used to promote efficiency and competitiveness in industry. According to local press reports, ADB reportedly also would participate in several infrastructure development projects in Mongolia by providing credits and assistance in the next 4 years. These infrastructure development projects include technical renovation of existing thermoelectric powerplants, construction of a hydroelectric powerplant on the Egyin-Gol River, and renovation of Ulaanbaatar airport.[34]

In late 1993, a credit of $20 million with a 40-year maturity was extended by the World Bank to Mongolia to help finance a $25 million economic transition support project to assist in the operation, maintenance, and development of the mining and transport sectors. The $20 million credit would be used mainly for the import of equipment, materials, spare parts, and other input needed in coal and copper mining and the transport sector in 1994.[35]

To attract foreign investors to participate in exploration and development of Mongolian mineral resources, the Ministry of Geology and Mineral Resources had completed drafting a new mining law in September 1992 with the World Bank's assistance. The draft reportedly had been reviewed by related Government agencies and had been sent to the State Great Hural for discussion. However, the revised draft reportedly had not been passed by the State Great Hural by the end of 1993.

In 1993, the State Great Hural adopted a new Foreign Investment Law, which became effective July 1, 1993. The purpose of the new Foreign Investment Law, embodied in 26 articles, was to encourage foreign-investment, to protect the investor's rights and property in Mongolia, and to regulate matters related to the operation of a foreign-invested business entity. Under this new law, all financial, material, and other resources of any foreign citizen, organization, or company will be protected by law under all circumstances except war. However, foreign investors are to comply with four conditions: to observe the laws of Mongolia, to fulfill contractual commitments, to implement measures for protection and restoration of the natural environment, and to respect the national customs and traditions of the Mongolian people.

Under this new law, a foreign-invested business entity is subject to taxation under the tax law of Mongolia. However, a number of fiscal incentives are provided for business entities using foreign or mixed capital. For example, under Articles 19 and 20, technological equipment and machinery forming part of

the registered capital of the foreign invested business entity shall not be subject to customs duties and sales tax. Raw materials, components, spare parts, and materials to be brought in for carrying out production activities shall not be subject to customs duties for 5 years.

A foreign-invested business entity in any of the following areas shall be subject to tax preferences as follows: (1) hydropower and thermal plants and power transmission networks, highway, railways, air cargo and engineering constructions, and a basic network of telecommunications shall be fully exempt from income tax for the first 10 years and 50% tax relief in the next 5 years; and (2) mining and processing of mineral resources (except precious metals), oil and coal, metallurgy, chemical production, machinery, and electronics shall be fully exempt from income tax for the first 5 years and 50% tax relief in the next 5 years.

Mongolia was the world's fifth largest fluorspar producer in 1993. Mongolia remained an important producer of copper and molybdenum in the region. The shortage of electric power, fuels, and supplies continued to have an adverse effect on the activity of the mining industry. As a result, minerals production except copper in 1993 was at a lower level than that of 1992. In 1993, Mongolia continued to conduct about 50% of its merchandise trade with Russia. According to a local press report, Mongolia's overall two-way merchandise exports declined by 10.46% to $722.4 million in 1993.

Exports of mineral commodities (mainly concentrates of copper, molybdenum, and fluorspar) were estimated at more than $215 million, accounting for about 60% of Mongolia's export earnings of $360.9 million in 1993. According to the Ministry of Trade and Industry, exports of major mineral commodities in 1993 were as follows: copper concentrate, 394,500 tons; fluorspar concentrate, 77,200 tons; and molybdenum concentrate, 2,908 tons. Because of a lack of mineral processing facilities, Mongolia continued to rely on Russia for processed mineral products to meet its domestic demand. Petroleum products, ferrous and nonferrous metal products, and fertilizer materials remained the major import components, accounting for about 40% of Mongolia's imports of $361.5 million in 1993. According to the Ministry of Trade and Industry, imports of petroleum products totaled $87 million in 1993. *(See table 1.)*

Commodity Review

Metals.—**Copper and Molybdenum.**—Production of copper and molybdenum concentrates from the Erdenet Mine in Bulgan Aymag of northern Mongolia increased slightly from those of 1992. A workstoppage, which began in late October at the Erdenet copper concentrating plant, reportedly continued into mid-December in 1993. As a result of this workers strike demanding a tenfold increase in wages, both production and earnings from copper were lower than the 1993 planned targets. The Mongolian-Russian joint venture of the Erdenet Combine, the Erdenet Copper Corp., is 51% owned by the Government of Mongolia and 49% by the Government of Russia.

In the past 2 years, the average ore grade of the Erdenet Mine had decreased to about 0.75% copper and the average metal content of the copper concentrate also had decreased to about 29% in 1993. The average metal content of the molybdenum concentrate was about 47% in 1993. Because of the change in the metallurgy of the ore, it became more difficult to depress the insoluble fraction. As a result, the copper content of the concentrate had decreased considerably. According to the World Bank, about 20% of the $20 million credit would be used for providing technical assistance to optimize or increase the copper content of the concentrate as well as for the import of equipment, materials, and spare parts to increase efficiency.[36]

Exports of copper concentrate rose to 394,500 tons in 1993 from 346,000 tons in 1992. In 1993, more than 200,000 tons of copper concentrate was exported to copper smelters in the Urals region of Russia and the Balkhash copper smelter in Kazakhstan and all molybdenum concentrate was exported to Russia. In the past 3 years, copper concentrate also had been exported to China, Finland, Japan, the Republic of Korea, the Netherlands, Slovakia, Switzerland, and the United Kingdom.

According to Japanese trade statistics, exports of copper concentrate to Japan rose to 32,109 tons in 1993 from 30,877 tons in 1992. Exports of copper concentrate to China were estimated at 35,000 tons in 1993, up from 30,491 tons in 1992. In 1993, China National Nonferrous Metal Industry Corp. (CNNC) sold explosives to Erdenet Copper and helped train Erdenet's Mongolian specialists. To pay for materials and services, Erdenet Copper was expected to continue exporting copper concentrate to China.[37]

Gold and Silver.—In an effort to double the gold mine production under the Program of Action, the Ministry of Geology and Mineral Resources reportedly was in the process of improving gold mining facilities of the Duvunt Mine in Bayan-Khongor Aymag. The Ministry also signed an agreement with Vancouver-based Mongolia Gold Resources Ltd. of Canada (MGR) in May to explore for gold and for subsequent production from the Bumbat Goldfield in the Zamamar Region, about 210 km west-northwest of Ulaanbaatar. Mongolia Gold Resources was the second Western firm licensed to exploit gold in Mongolia. The joint-venture firm, which is expected to be established following a feasibility study in September 1993, will be 51% owned by the Ministry of Geology and Mineral Resources and 49% by MGR. According to data collected earlier by Russian and Mongolian specialists, at least 7 out of about 200 narrow gold-bearing quartz veins reportedly have potential. One of the 7 promising gold-bearing veins indicates undiluted geological resource of 450,000 tons grading 16 g of gold per ton of ore. The total gold ore resources had been estimated at about 1 Mmt.[38]

Morrison Knudsen Gold Co., a majority-owned subsidiary of Morrison

Knudsen Corp. (MK) of the United States, reportedly shelved its joint-venture project with Mongol Erdene, a Mongolian state-owned trading and mining company, to develop and produce gold from the Boroo deposit in Tov Aymag. According to MK, the feasibility study conducted in 1993 based on 1992 confirmation drilling indicated that it would not be economically viable to develop the gold deposit at prevailing market conditions.

According to the new Foreign Investment Law enacted in July 1993, mining and processing of gold and silver by a foreign invested business entity shall be subject to the full income tax rate without any fiscal incentives.

Iron and Steel.—There was no production of iron ore in Mongolia. However, the Government had identified three significant magnetite deposits, all in Selenge Aymag in north-central Mongolia. The Tumurtei deposit, about 100 km northeast of Darhan, was estimated to have 136.9 Mmt of reserves averaging 50% to 54% iron. The Bayan Gol deposit, about 70 km northeast of Darhan, was estimated to have 110.1 Mmt of reserves averaging 15% to 52% iron. The Tumur Tolgoi deposit, about 30 km southeast of Darhan, was estimated to have 20.2 Mmt of reserves averaging 52% to 57% iron.

In October, Mongolia's first and only minimill, about 3 km southeast of Darhan with a 100,000-mt/a capacity, was inaugurated and began its first phase operation in late November. Construction of the $61 million minimill took about 3-years following the signing of an agreement between the Government and C. Itoh and Mitsubishi Heavy Industries Ltd. (MHI) of Japan in 1990.

The construction of the plant was by Mongolia's Narfan Metallurgical Combinate and a Russian construction company under the supervision of the Mongolian Project Chief Engineer and Advisers from the Civil and Architecture Engineering Section of MHI. The project was financed by a $61 million loan from the Import-Export Bank of Japan.

Equipment and facilities for the mill, including two 25-ton electric arc furnaces, a three-strand continuous casting machine, a hot-rolling mill, a power substation, and water-treatment facilities, were supplied by MHI and its subcontractor in Japan. The mill has about 300 workers. Most of the steelworkers, including engineers, were sent to Japan for training. According to the Project Chief Engineer, iron and steel scrap to be used as raw material had been collected and was sufficient to meet the requirements for the next 2 to 3 years of operation. For the electric power supply, a 20,000-kV•A powerplant using imported fuel oil had been built by the Government near the mill.

Lead and Zinc.—Following the signing of an agreement with the Government of Mongolia in 1992, the Metal Mining Agency of Japan (MMAJ) began its prefeasibility study for the Tsav lead-silver-zinc deposit in Dornod Aymag in the northeastern Mongolia. An exploration team, consisting of representatives from MMAJ, Mitsui Mining and Smelting Co., and other mining companies, reportedly visited Mongolia. Equipment and supplies for an extensive boring program to verify lead, silver, and zinc reserves of the deposit were to be shipped from Japan in the fall. A detail drilling program was expected to begin in September and be completed by February 1994.[39]

Industrial Minerals.—**Cement.**—Cement production increased considerably in 1993 owing mainly to increased exports to China. Production of cement was by Hutol Cement and Lime Combine in Hutol (Khutul) and Darhan Cement Co. in Darhan, both in Selenge Aymag of northern Mongolia. Hutol Cement and Lime Combine, which operated a 500,000-mt/a cement plant and 65,000-mt/a hydrated lime plant using Russian technology and equipment, produced 200,000 tons of cement in 1993. The Hutol combine, about 65 km southwest of Darhan, also operated a 750,000-mt/a limestone quarry, about 7 km north of the cement plant. The work force at the combine was about 1,000, of which about 52% were female workers.

Darhan Cement, which operated a 150,000-mt/a-capacity plant using Czechoslovakian technology and equipment, produced about 70,000 tons in 1993. Mongolia exported about 100,000 tons of cement mainly to China in 1993.

Fluorspar.—Production of direct-shipping metallurgical-grade fluorspar ranging between 45% CaF_2 and 95% CaF_2 for exports, mainly to Russia for iron and steel production, was estimated at 100,000 tons. Production of acid-grade calcium fluoride was estimated at 80,000 tons. The sharp decline in the 1993 overall production of fluorspar was mainly due to the closure of the Chuluut Tsagaan Del Mine in Tov Aymag in early 1992 and reduced exports of both metallurgical-grade fluorspar and acid-grade calcium fluorite (fluorspar concentrate) to Russia.

Fluorspar was produced principally by Mongolsovtsvetmet, a joint venture of Mongolia (51%) and Russia (49%). Mongolsovtsvetmet operated an underground mine and an open pit mine as well as a fluorspar concentrator at Bor Ondor in Hentiy Aymag. It also operated open pit mines at Khar-Airag, Khajuu (Khazhu) Ulaan, and Urgon (Orgon) in Dorngovi Aymag and an underground mine at Berh in Henity Aymag. In an effort to expand its product market into the Western World, Mongolsovtsvetmet was upgrading the existing concentrating facilities to raise the content of calcium fluorite in the concentrate from 94% to between 96% and 98%. Metallurgical-grade fluorspar produced from the Berh Mine and the Urgon Mine was exported to Russia.

Mongol-Czechoslovakmetal, which operated an open pit mine with a capacity of 45,000 mt/a at Chuluut Tsagaan Del in Tov Aymag, remained shut down in 1993.

Mineral Fuels.—**Coal.**—Coal production dropped to a 7-year low in 1993 because of the continued shortage of fuel for power, spare parts for mining equipment, and tires for dump trucks. According to the Ministry of Fuel and

Energy, less than 15 coal mines were operating in 1993. However, only the Baga Nuur Mine, the Shariyn Gol Mine, and the Shivee Ovvo Mine produced substantial amounts of coal. In 1993, the Baga Nuur Mine, the country's largest coal mine, produced 3.2 Mmt, the Shariyn Gol Mine produced 1.4 Mmt, and the Shivee Ovvo produced 643,000 tons. The Nalaikh Mine, an underground mine, about 35 km southeast of Ulaanbaatar, reportedly was shut down in early 1993.

About 25% of the $20 million from the Economic Transition Support Credit of the World Bank would be used for the Baga Nuur and Sgaryn Gol Mines to improve existing operating practices, productivity, and efficiency. In mid-1993, a $20.5 million contract was awarded by the U.S. Agency for International Development to Morrison Knudsen Corp. for assisting Mongolia to improve its coal and power production. According to the Ministry of Fuel and Energy, the Government planned to increase production capacity of the Baga Nuur and the Shivee Ovvo Mines from 4 Mmt/a and 1 Mmt/a, respectively, to 6 Mmt/a and 1.5 Mmt/a, respectively, through a modernization program.

Petroleum.—Mongolia had not produced oil and gas from its Zuun Bayan Oilfield in Donogovi Aymag since 1970. All of Mongolia's requirement for refined petroleum products were met by imports principally from Russia. According to the Ministry of Trade and Industry, imports of fuels, which included gasoline, diesel, aviation fuel, fuel for boilers, and lubricants, amounted to $87 million and accounted for 24% of Mongolia's imports in 1993.

To seek technical and financial assistance from the Western World for exploring oil and gas in Mongolia, the Government through Mongol Gazryn Tos (MGT), the Mongolian state-owned petroleum company, signed two separate agreements with two foreign companies in 1993. A production-sharing contract was signed between MGT and SOCO International Oil Corp., a subsidiary of Snyder Oil Corp. of the United States, for exploring oil and gas in Tamtsag basin in Dornod Aymag of eastern Mongolia. According to the agreement, which was ratified later by the State Great Hural, SOCO was granted all rights to conduct geological and geophysical works and development oilfield in the XXII contract area (11,400 km^2) in Tamtsag basin, to provide technical and economic aid to the study and development of oil in Tsagaan Els in southeastern Mongolia, and to share profits 50-50 from Tamtsag Oilfield.[40]

In August, MGT signed another agreement with Nescor Energy Co. of Australia granting Nescor exploration and development rights in the XIII contract area (14,600 km^2) in Tsagaan Els basin in East Gobi of southeastern Mongolia.[41]

Uranium.—Uranium mining in Mongolia was by a Russian company called Erdes, which operated an open pit mine on a long-term lease near Marday of Dashbalbar district in Dornod Aymag of eastern Mongolia. According to the Government of Mongolia, the Erdes' uranium mine has an annual capacity of 100,000 tons. In addition, there were two closed underground mines in the same area, both seeking investors to reopen the mines.

In December, the Ministry of Geology and Mineral Resources through the Uran Co., the state-owned uranium company, signed an agreement to explore jointly for uranium with Concord of the United States and Geologorazvedka of Russia in the Gobi region, including the Aymags of Dornodgovi, Omnogovi, Dundgovi, and Sukhbaatar. According to the agreement, Concord will control 70% of the joint venture and be responsible for funding of a $4 million geological survey of the area and be responsible for managment and product marketing. The Mongolian and Russian partners will split the remaining 30% interest and be responsible for carrying out geological surveying and for uranium mining. Actual prospecting work was expected to begin in 1994.[42]

TABLE 8

MONGOLIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992[p]	1993[e]	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic[3]	thousand tons	513	441	227	r133	270	500
Coal:[3]							
Anthracite and bituminous	do.	645	591	588	r570	500	700
Lignite and brown	do.	7,400	6,557	6,450	5,400	5,200	9,000
Total	do.	8,045	7,148	7,038	r5,970	5,700	9,700
Copper, mine output, Cu content[3]		123,550	123,900	90,100	105,100	117,000	125,000
Fluorspar:[3]							
Acid grade	thousand tons	115	119	120	97	80	120
Metallurgical grade	do.	586	495	250	180	100	600
Total		701	614	370	277	180	720
Gold, mine output, Au content	kilograms	1,200	1,000	800	900	850	1,500
Gypsum	thousand tons	30	30	25	25	25	30
Lime, hydrated and quicklime	do.	95	103	76	50	55	120
Molybdenum, mine output, Mo content[3]		1,580	1,578	1,716	1,522	2,100	1,600
Salt		16,000	17,000	17,000	17,000	18,000	17,000
Silver, mine output, Ag content	kilograms	21,200	21,200	15,500	18,000	17,500	22,000
Tin, mine output, Sn content		1,200	320	250	190	150	200
Tungsten, mine output, W content		600	500	300	260	250	300

[e]Estimated. [p]Preliminary. [r]Revised.

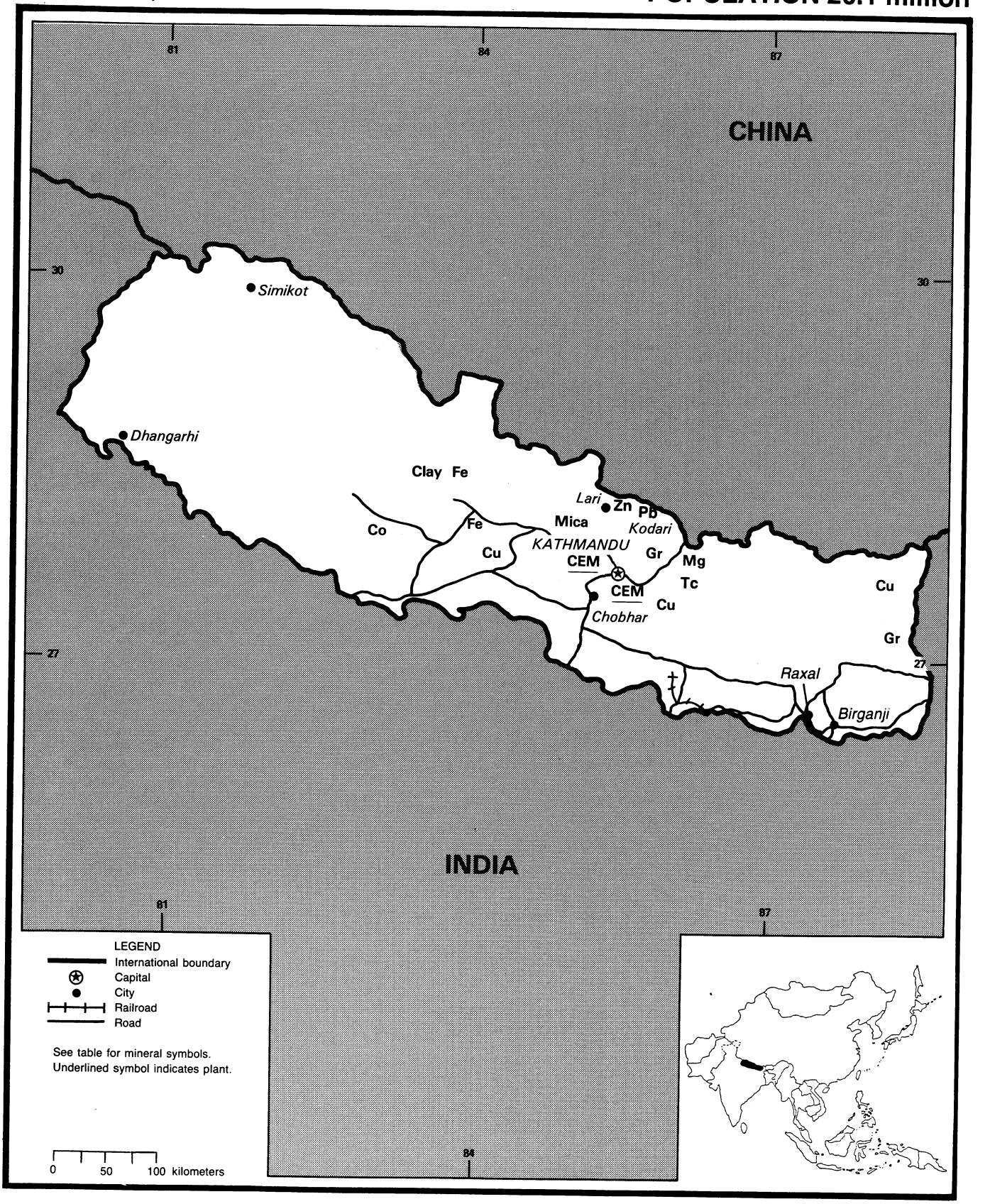
[1]Table includes data available through Aug. 12, 1994.

[2]In addition to the commodities listed, crude construction materials such as sand and gravel, varieties of stone such as limestone, silica sand, and uranium presumably are produced, but available information is inadequate to make reliable estimates of output levels.

[3]Reported.

NEPAL

AREA 140,800 km² **POPULATION 20.1 million**



NEPAL[43]

The Kingdom of Nepal, a small landlocked country with an area about the size of Arkansas, is bordered on the north by Tibet of China, on the east by Sikkim and West Bengal of India, and on the south and west by Bihar and Uttar Pradesh of India. Nepal remained one of the poorest nations in the world with a per capita income of about $180[44] in 1993. Nepal's mineral resources, identified by its Department of Mines and Geology under the Ministry of Industry, include beryl, clays, coal, copper, dolomite, gemstone, gold, iron ore, lead, limestone, magnesite, mica, silica sand, construction stone, talc, tin, and zinc. Among these minerals, only clay, coal, gemstones, limestone, marble, magnesite, and talc currently were being mined.

Nepal's mining sector, comprised mainly of several small-scale industrial minerals mining companies, is the smallest sector of the Nepalese economy. Nepal's gross domestic product (GDP) was estimated to have grown 3% to $3.2 billion in 1993. The output of the mining and quarrying industry was valued at about $6.4 million or 0.2% of Nepal's GDP. Nepal's mineral processing industry consisted of three cement plants, a dead-burned magnesite processing plant, and a talc processing plant.

Mining operations of various industrial minerals by privately owned small mining firms are sparsely distributed throughout the country. Limestone was mined for the production of cement and lime and for construction materials. Boulders, clays, marble, and sand were mined for domestic consumption as well as for export to India. Nepal produced a small amount of coal, but most of the coal requirements for cement production and other uses were met by imports from India. The Nepal Coal Co., which had a purchase agreement with India, imported about 125,000 tons of coal annually.

Mining of crude magnesite was by Nepal Orind Magnesite Ltd. at Kharidhunga and Lamusangu, to the northeast of Kathmandu (national capital) in the Dolkha mining district. Nepal Orind Magnesite, which is 50% owned by the Government and 50% by Orissa Industries Ltd. of India, completed construction of a crushing plant at Kharidhunga as well as a 50,000-mt/a dead-burned magnesite processing plant (shaft kiln) and a 10,000-mt/a talc processing plant at Lamusangu in 1988. Processing technology was supplied under a licensing agreement between Orissa Industries and Harbison-Walker Refractories of the United States. The processing plants never went to commercial operation and were shut down in 1991-93 because of magnesite processing problems. Investigation of the problems, financed by a $500,000 grant from a United Nations Development Program (UNDP), was completed in 1992. According to recommendations for corrective action made by the Australian contractor, additional investment for a three-staged redevelopment plan is necessary to salvage the ailing project.

Production of cement was estimated to be at a lower level than that of 1992 because of the shortage of good-quality coal and high-grade limestone. The Himal Cement Co. Ltd. operated a 100,000-mt/a plant at Chobhar. Hetauda Cement Ltd. operated a 260,000-mt/a plant at Hetauda. Udayapur Cement Industry Ltd. operated a 277,200-mt/a plant at Jaljale. According to local press reports, both Udayapur Cement and Hetauda Cement shut down in mid-1993 because of a shortage of high-quality limestone. Udayapur Cement's limestone shortage was due to an inadequate supply system caused by the delay in installation of a 20-km ropeway for transporting limestone to the plant site, while Hetauda Cement's shortage of limestone was due to road damages in the mining area caused by heavy monsoon rains.[45] Himal Cement, however, produced about 63,000 tons in 1993 compared with about 45,000 tons to 50,000 tons in 1990-92 and made a profit for the first time in 4 years.[46]

The $1.6 million feasibility study, funded by UNDP, for a decision on commercial development of the Ganesh Himal lead-zinc-silver deposit was completed in April 1993. According to the summary of the report, the proven reserves of the Ganesh Himal deposit, at the border of Rasuwa and Dhading districts, were estimated at 872,000 tons, grading 13.3% zinc, 2.13% lead, and 27 g of silver per ton of ore, with the potential to increase reserves by additional drilling. A 400-mt/d underground mine would require a capital cost of $22.8 million and operating costs of $33.01 per ton of ore. The annual rate of return on equity capital would be about 7.24%. However, the rate of return could be significantly increased by using reconditioned mill equipment and by increasing ore reserves. Nepal Metal Co., the owner and operator of the Ganesh Himal project, is seeking development financing. Nepal Metal is 50% owned by the Government, 25% by Hyderabad Industries of India, and 25% by K.K. Bamford & Co. Ltd. of Hong Kong.[47]

According to the Department of Mines and Geology, mineralization of gold and uranium had been found in boulders carried by the Chamaliya River on the boundary between Darchula and Baitadi districts in western Nepal in late 1992.

Nepal has 7,080 km of roads, of which 2,898 km is paved, 1,660 km gravel or crushed stone, and 2,522 km of seasonally motorable tracks. It also has 52 km of 0.762-m-gauge railroad, all in Terai close to the India border. The 10 km from Raxal to Birganji is Government-owned. The country has five major airports with permanent-surface runways. Telephone and telegraph services are poor. Nepal has 300,000 kW of electricity generating capacity and produced about 1 billion kW•h of electricity for consumption by Kathmandu and several larger cities, but there is no national power distribution and transmission system.

Nepal's enormous hydroelectric potential remains largely untapped. To develop its hydroelectric power, the Nepalese Government announced a new hydropower development policy in 1992. Under the new policy, small hydropower projects will be constructed in the hilly and Himalayan regions; the rural electrification system will be adequately extended, and private local and foreign

investment will be encouraged.

The outlook for development of the Nepalese economy relies very much on foreign financial and technical assistance. Japan is currently a leading aid donor, followed by the United States, Germany, the United Kingdom, Switzerland, Finland, Canada, China, and India. Various United Nations affiliated international organizations, such as UNDP and the World Health Organization, were among the important multilateral donors. Infrastructure projects in progress were several small hydroelectric power stations, bridge construction, installation of a high-power transmission line between Nepal and India, and the construction of a highway in western Nepal. The potential for mineral development remains largely untapped.

TABLE 9
NEPAL: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity[3]		1989	1990	1991	1992[p]	1993[e]	Annual capacity[e] (Jan. 1, 1994)
Beryl	kilograms	900	e1,000	e1,000	1,062	1,000	1,000
Cement, hydraulic		217,666	107,179	135,897	196,005	180,000	250,000
Clays for cement manufacture		7,206	824	8,850	8,850	7,500	10,000
Coal: Lignite		9,639	7,808	10,150	10,350	10,500	12,000
Copper ore:							
Gross weight		20	18	22	20	20	35
Cu content		7	6	4	7	7	12
Gemstones:[e]							
Garnet	kilograms	25,000	20,000	e22,000	e25,000	22,000	25,000
Tourmaline	do.	20	20	5	20	20	25
Lime, agricultural		40,500	e45,000	24,500	e24,500	24,000	50,000
Magnesite, crude		27,978	e25,000	e25,000	e25,000	25,000	45,000
Salt		7,200	6,900	7,300	e7,000	7,200	7,500
Stone:							
Limestone		289,743	e295,000	221,920	e222,000	200,000	350,000
Marble:							
Chips		57	945	778	281	300	1,200
Cut	square meters	23,448	46,892	34,306	16,678	20,000	50,000
Craggy	do.	68,954	5,318	e6,000	922	1,000	70,000
Talc		6,728	1,798	3,500	3,170	3,500	7,000

[e]Estimated. [p]Preliminary.

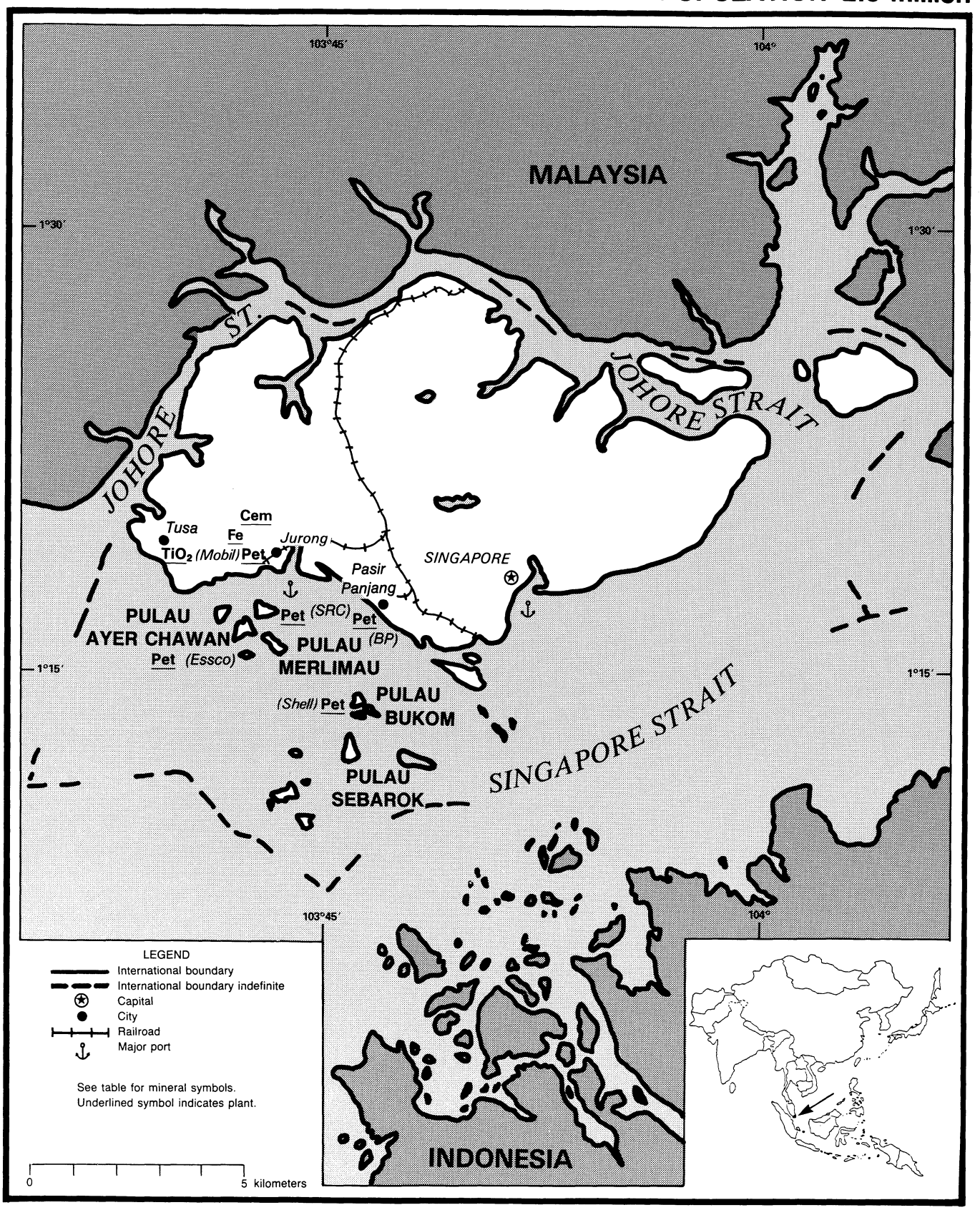
[1]Table includes data available through Aug. 12, 1994.

[2]Data are for the fiscal year ending mid-July of that stated.

[3]In addition to the commodities listed, construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

SINGAPORE

AREA 623 km² **POPULATION 2.8 million**



SINGAPORE[48]

Singapore is a city state with only 3 million people and limited natural resource. In the early 1960's, Singapore promoted itself throughout the world as a place in the Asia-Pacific region with political stability, a well-developed infrastructure, and high-quality and low-cost labor. Since the late 1980's, these privileges were increasingly challenged by neighboring countries such as China, Indonesia, Malaysia, and Thailand. Therefore, Singapore's new strategy was to place itself as a regional service hub focusing on advanced electronic, aerospace, financial service, and oil refining. Singapore is considered to be the fifth most important financial center in the world behind London, New York, Tokyo, and Hong Kong because the country is placed on the advantage of the strong economic growth in the Southeast Asia region in the 1990's.

In the past 2 years, Singapore's economic growth appeared to be slowed down due the worldwide recession. In 1993, the country's economic growth rebounded to 9.8% over that of the previous year. Unlike Hong Kong, Singapore's Government has kept the inflation rate low, below 3%. The Consumer Price Index (CPI) was 2.5% in 1993. The Government will introduce a 3% Goods and Service Tax beginning in April 1994, which is expected to increase the CPI to 3% in 1994.

Petroleum products were Singapore's second most important manufacturing output behind electronics. Petroleum products and mineral fuels were the country's largest exports, accounting for 12.2% of the total exports in 1993. Because of its geographical location, at the center of the supply chain from Middle East to Asian countries, Singapore is the world's third largest refining center after Rotterdam and Houston. Major oil companies such as Exxon, Mobil, and Shell began building their refineries in Singapore in the early 1960's. Currently, there are five refineries in Singapore with a total refinery capacity slightly more than 1 Mbbl/d. These refineries have the capability to process more than 40 different kinds of crude oil, ranging from low-sulfur crude oils, mainly from the Middle East, to high-sulfur crude oils from Asian countries such as China, Malaysia, and Indonesia. Singapore has evolved itself as the most versatile and advanced technologically refineries in the Asia and Pacific region.

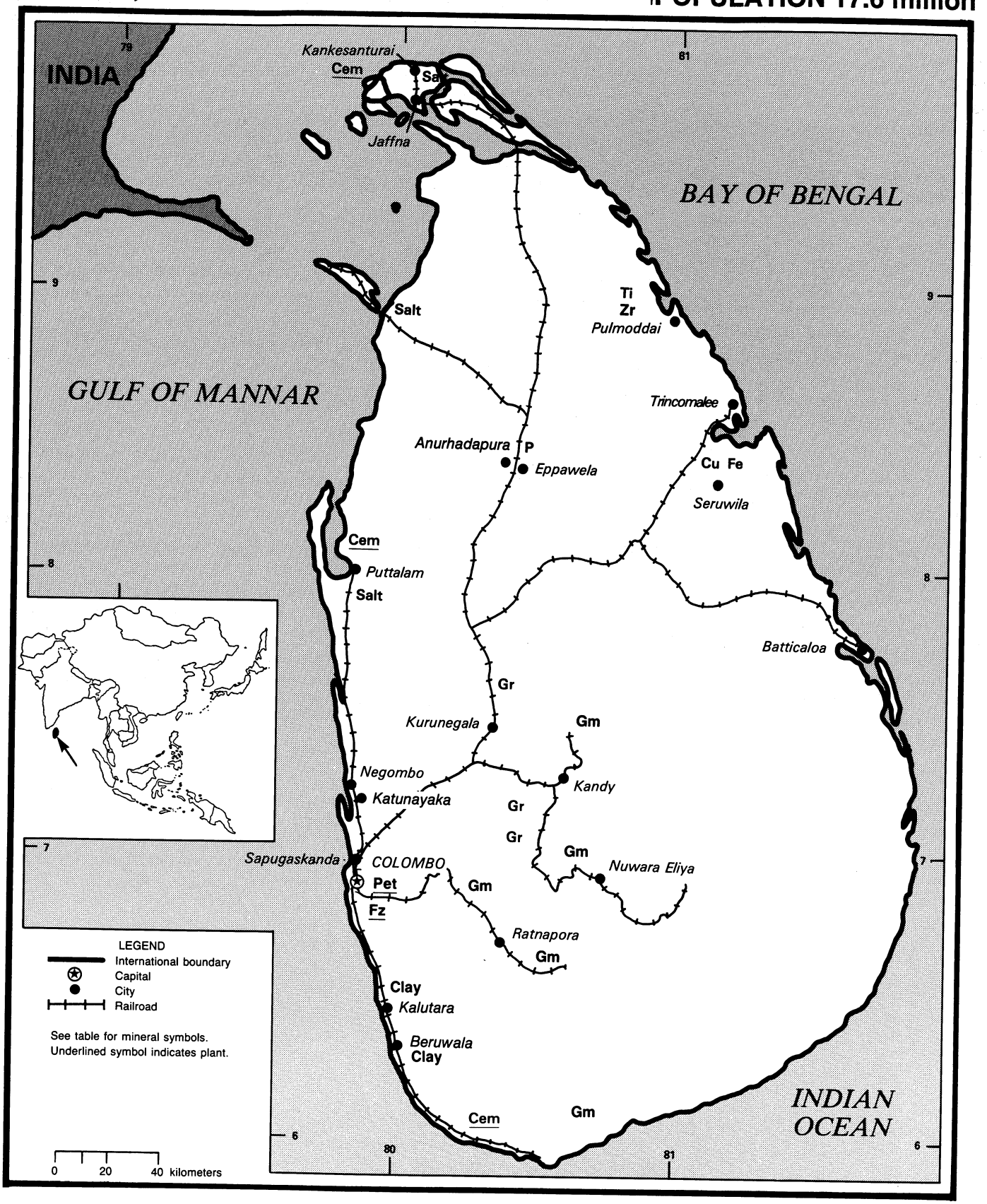
Singapore's refiners have invested heavily in expanding and upgrading their facilities through Government incentives such as tax reduction, investment allowances, and accelerated depreciation for refinery products. Therefore, refiners planned to increase the total crude oil refining capacity by 15% to 1.27 Mbbl/d in 1995. In 1993, Esso Singapore Private Ltd. (ESPL), a subsidiary of Exxon Oil Co. of the United States, announced that ESPL would invest $237[49] million to build a 15,000-bbl/d hydroprocessing unit at its refinery. ESPL will join with Amoco and China American Petrochemical Co. to invest $900 million to build an aromatic complex to produce 350,000 tons of paraxylene and 90,000 tons of benzene.

Mobil Oil Co. invested $760 million to build a petrochemical plant, including a continuous catalytic reformer and an aromatic complex, which will be commenced in early 1994. Caltex Oil Co. planned to invest $830 million to upgrade its Pulau Merlimau Refinery. According to the plan, Caltex will build a 33,000-bbl/d residue catalytic cracker plant that can convert low grade fuel oil into a more valuable petroleum products. Also, Caltex selected Singapore as its headquarter for trading oil activities because Singapore is the third largest international oil trading center behind New York and London in the world.

The United States continued to be Singapore's largest trading partner, and its immediate economic outlook hinges on the U.S. economic recovery. The Government encourages Singaporean firms to invest abroad to increase the country's external income. The Government has been very active in promoting investment in China. Also, Singapore is a strong proponent of regional economic integration. The country is one of the promoters of the Association of Southeast Asian Nations free trade area, which was implemented on January 1, 1993. Owing to the country's open trade policies, excellent transportation and communication infrastructure, and skill labor force, Singapore has became an excellent gateway to the rapidly growing markets of Southeast Asia.

SRI LANKA

AREA 65,610 km² **POPULATION 17.6 million**



SRI LANKA[50]

Sri Lanka's economic growth increased to 6.7% in 1993. Expanded exports of traditional crops and manufactured goods contributed to the high growth rate. Crop output recorded a rise of 17% while export of manufactured goods grew almost 33%. Another major factor in the increase in gross domestic product (GDP) and external assets was the rapid growth in private remittances from Sri Lankan expatriates and capital inflows. Remittance from abroad reached $640 million[51] during the year. Total investment rose 24%, funded by growth in national savings and capital infows. The budget deficit was kept at the targeted 8% of GDP, and the current account deficit fell to 3.8% of GDP. Defense allocation of $44 million accounted for one-fifth of the budget and 6% of GDP. Per capita income increased to $630 for the year.

The Government encouraged foreign investment in the manufacturing, construction, and service sectors. Political stability and the most sustained economic growth in south Asia made Sri Lanka a country for lucrative investment with considerable potential. The Government's program of privatizing state-owned industries and enterprises was accelerated. Thirty unprofitable companies were privatized. Infrastructure development was also high on the agenda to attract foreign investment. With a literacy rate approaching 80%, the country had the most educated workers in the region. The estimated unemployment rate dropped to 11.5% in 1993.

The value of Sri Lanka's exports for the year increased to $2.8 billion while that of imports grew to $4 billion. The trade gap widened 10% to $1.2 billion as export earnings rose 16% while import expenditures increased 15%. Industrial exports accounted for 73% of total exports and included garments, textiles, diamonds, and petroleum. Nonmetallic mineral and base metal production recorded substantial growth. Agricultural exports included tea, rubber, and minor crops.

Unofficial exports of gemstones were worth as much as $300 million per year and ranked after those of garments and tea. Official exports and unrecorded purchases by foreign tourists boosted the value of exports to $22.8 million in 1993. The Government moved toward a more liberal export-import program and toward almost complete freedom of exchange control. The gem industry had been slow to invest in the specialized furnace needed for heat treatment of gemstones. The Government also had been slow to add value by using the thousands of tiny less valuable gems in developing its jewelry export sector. There was little vertical integration in the gem industry, and many gem cutters operated on a cottage industry basis. With foreign capital and assistance, the cutting and polishing of imported diamonds grew to annual exports at $182.4 million, up 16% from last year's. The country's gem mining, cutting, and jewelry business employed 300,000 people. About 25% of Sri Lanka's land was reported to be potentially gem bearing and 80% of gems was underground.

Demand for kaolin boomed and Lanka Ceramic Ltd., the largest kaolin producer, increased output at its Boralesgamuwa Mine in Colombo district and its Meetiyagoda Mine in Galle district. Capacities of these two mines were 5,000 mt/a and 3,000 mt/a, respectively. The company planned to increase production of its Super Grade porcelain kaolin, boost its geological surveying efforts, and acquire more land.

The country imported crude oil from Iran, Malaysia, United Arab Emirates, and Egypt, in descending order. The Shapugaskande oil refinery of the Ceylon Petroleum Corp. met more than 85% of Sri Lanka's requirements of petroleum products. Output for petroleum products in 1993 amounted to 1.7 Mmt, and some kerosene and aviation fuel were exported.

The Government assumed responsibility for the infrastructure and opened its entire development to foreign investment. In the power sector, one of the largest projects was a coal-fired 150-MW plant in Trincomalee in which Canadian and Japanese companies were interested. The project's second phase called for the addition of a 150-MW plant. Likewise, 50 foreign companies had expressed interest in developing the southern port of Galle. Foreign companies were invited to participate in projects on build-own-operate and build-operate-transfer terms. Foreign investment and capital had been rising, particularly in the once-dormant Colombo stock market.

TABLE 10

SRI LANKA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993[p]	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic	thousand tons	e400	e400	e400	817	676	1,400
Clays:							
Ball clay		20,866	27,695	e25,000	18,558	21,017	—
Kaolin		7,761	7,731	7,737	6,759	e7,000	—
Brick and tile clay[e]		60,000	60,000	75,000	75,000	[3]7,722	—
Clays for cement manufacture[e]		12,500	12,500	[3]320	300	400	—
Feldspar, crude and ground		6,656	9,698	9,908	7,524	e8,000	—
Gemstones, precious and semiprecious, other than diamond[e]	value, thousands	$14,000	$14,000	$57,000	$58,000	$60,000	—
Graphite, all grades		4,163	5,469	6,381	3,307	5,163	11,000
Iron and steel: Metal: Semimanufactures		e35,000	33,422	47,659	53,811	39,015	60,000
Mica, scrap[e]		200	200	200	200	200	—
Petroleum refinery products:							
Gasoline	thousand 42-gallon barrels	3,128	5,460	1,168	957	1,390	—
Jet fuel	do.	384	805	722	553	724	—
Kerosene	do.	961	1,325	1,173	985	1,464	—
Distillate fuel oil	do.	3,327	4,345	3,450	2,700	3,980	—
Residual fuel oil	do.	—	—	3,801	4,383	3,753	—
Other	do.	1,166	620	1,030	471	240	—
Refinery fuel and losses	do.	553	630	464	428	461	—
Total		9,519	13,185	11,808	10,477	12,012	50,000
Phosphate rock		24,440	32,564	19,693	26,010	35,681	—
Rare-earth metals: Monazite concentrate, gross weight[e]		200	200	200	200	200	
Salt		150,223	53,031	52,888	121,875	43,344	—
Stone:							
Limestone	thousand tons	608	642	621	e600	e650	—
Quartz, massive		961	1,300	978	1,130	1,133	—
Titanium concentrate, gross weight:							
Ilmenite		101,354	66,413	60,861	33,283	76,930	—
Rutile		5,589	5,460	3,085	2,741	2,643	—
Zirconium: Zircon concentrate, gross weight		21,983	19,727	26,123	13,368	14,401	—

[e]Estimated. [p]Preliminary.

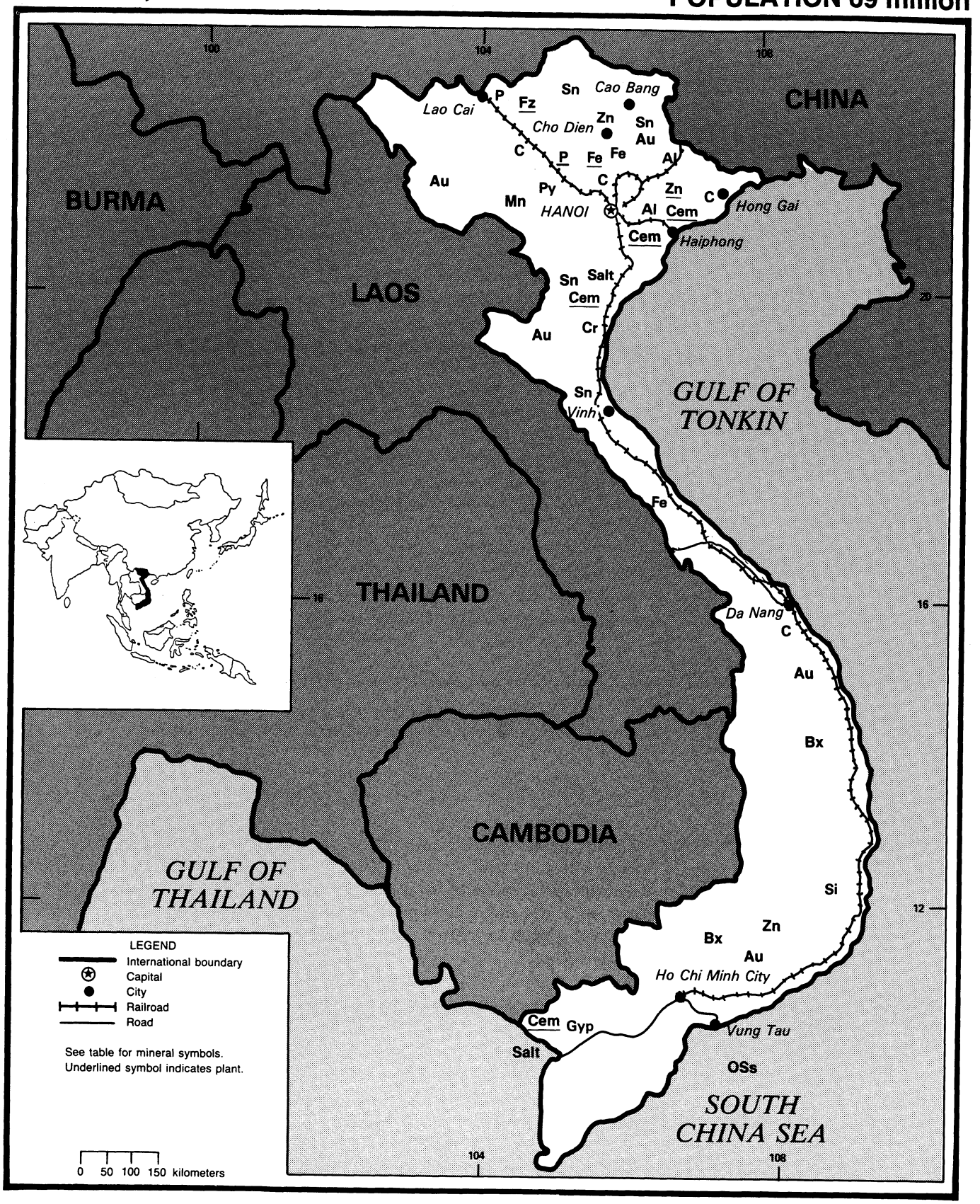
[1]Table includes data available through July 22, 1994.

[2]In addition to the commodities listed, crude construction materials such as sand and gravel and varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

[3]Reported figure.

VIETNAM

AREA 330,000 km² **POPULATION 69 million**



VIETNAM[52]

The Socialist Republic of Vietnam has had a centrally planned economy since 1976, when the former northern and southern areas partitioned in 1954 by the Geneva accords were officially reunited. Its economy has been one of devastation since 1945, when Japan's World War II occupation ended and the country first proclaimed independence. However, the economy in 1993 continued its 1990's proclivity of expansion; real gross domestic product (GDP) growth in 1993 was about 8%.

The National Assembly passed in late December the country's first environmental protection law in an effort to prevent further degradation of the environment as the country progressed toward development resulting from the Government's policy of "doi moi" (economic renovation). The law provided only a general framework for environmental protection; the task of developing implementing instructions to regulate such environmental problems as industrial discharge, toxic gas, air standards, and water quality was assigned to the National Environmental Protection Agency, an agency under the Ministry of Science, Technology, and Environment. Vietnam already had adopted laws, or promulgated decrees, on the protection of its natural resources, including minerals, but thus far these have been rather ineffective.[53]

"Doi moi" was initiated in 1986 and accelerated in 1989 to introduce a free market to the country without ejecting the authoritarian Communist Government. The Government continues to encourage private enterprise and trade under the policy to stimulate the transition from a centrally planned to a market economy.

The economy remains basically agrarian, accounting for approximately one-half of the country's GDP and employing about 70% of the labor force. Rice cultivation predominates. Inflation during 1993 was estimated to have decreased to an annual rate of less than 10%, after having exceeded 65% and 80% rates in 1990 and 1991, respectively. Inflation in 1992 was held to less than 20%.

Although the U.S. Government authorized in 1992 and 1993 U.S. corporations to open offices in Vietnam; negotiate and sign joint-venture contracts with the Vietnamese; bid on large infrastructure projects being underwritten by the World Bank, the Asian Development Bank, and the International Monetary Fund; and participate in other advance activity heralding normal business endeavors, U.S. firms were barred throughout 1993 from selling any of their products or from conducting usual business practices in the country under the constraints of the U.S.—led economic embargo established in 1975.

Vietnam is rich in numerous minerals, including bauxite, chromite, coal, copper, gold, iron ore, lead, manganese, petroleum, phosphate rock, tin, tungsten, and zinc. With the exception of petroleum, the mineral resources are predominantly in the northern region of the country. The major petroleum fields occur on the wide continental shelf off the southern coast in the South China Sea.

Exports of crude petroleum in 1993 continued to be the country's leading foreign exchange earner from the mineral sector, accounting for almost one-half of the country's estimated $3 billion[54] in exports. Coal also remained an important mineral export.

Despite the Government's policy of "doi moi," the mineral resources in Vietnam remained under state ownership and, with the exception of the petroleum sector, all mines and mineral processing plants were owned and operated solely by the Government. Petroleum exploration, development, and production sharing projects were joint ventures between the Vietnam Oil and Gas Corp. (Petro Vietnam), the state oil company, and foreign companies. In addition, some mining, primarily for gold, was done by individuals. The state-owned National Gold, Silver, and Precious Metals Corp. in Hanoi refined all the gold mined in the country.

A consortium comprised of United Kingdom-based Lonrho and the German firms Krupp-Hoesch and Rheinbraun concluded near yearend an agreement with the Vietnamese Government to explore and develop the Thach Khe iron ore deposit 350 km south of Hanoi. A prefeasibility study completed during the year by the consortium indicated reserves of 350 Mmt grading 61.9% iron. The consortium planned to complete a detailed feasibility study by yearend 1994, with development of the mine for production of 10 Mmt/a of ore to commence by 2000, if warranted. All the ore would be exported.[55]

Padaeng Industry Co. Ltd. of Bangkok, Thailand, was granted a license by the Vietnamese Government to explore for zinc mineralization in Bac Thai Province about 150 km north of Hanoi. Padaeng, operator of the only zinc smelter in Southeast Asia, entered into a joint venture with the Government's Vietnam Rare and Precious Minerals Corp., on an 85-15 partnership basis, to explore for additional reserves surrounding the 600,000-ton zinc ore deposit delineated in the Cho Dien area by the French colonial Government in the early part of the century.[56]

Vietnam has a variety of coals, ranking from lignite to anthracite. Anthracite was for many years the chief mineral commodity produced in Vietnam. The principal coal mines are in Quang Ninh Province near Haiphong in the north and in Quang Nam Province near the city of Da Nang in central Vietnam. The Government was planning to increase production to about 15 Mmt/a from the present capacity of about 9 Mmt/a through the introduction of new, modern mines, although these plans appear rather formidable and may be more credible as a product of ardent imagination. The industry remained constrained by frequent failure with equipment and shortages with supplies, so that existing mines continued to operate at little more than 60% of design capacity. The state-owned Vietnam National Coal Import-Export and Materials Supply Corp. was responsible for all coal exports.

The country's oil industry emerged in the early 1970's with assistance from the

former U.S.S.R. and has become the premier mineral resource in Vietnam's economy. After production almost trebled in 1992 over that of 1991, production in 1993 leveled off somewhat; however, it still was estimated to have increased almost 20% over that of 1992. The state-owned Oil and Natural Gas Import-Export Co. managed all crude oil exports. All production was from the Bach Ho (White Tiger) offshore oilfield by the Vietnam-Soviet Oil and Gas Joint Enterprise (Vietsovpetro), the operating company jointly owned by the Russian and Vietnamese Governments. A second oilfield, the Dai Hung (Big Bear), was being developed by oil companies from Australia (BHP Petroleum International Pty. Ltd., the operator with a 43.75% interest), Malaysia (Petronas Carigali Sdn. Bhd., 20%), France (Total, 10.625%), and Japan (Sumitomo Corp., 10.625%), as well as Petro Vietnam (15%). Production, initially scheduled to start in August 1994, was rescheduled late in 1993 to commence near yearend 1994.[57] Starting production was planned at about 30,000 bbl/d of oil, reaching a maximum of 200,000 bbl/d by 1998.[58] Exploration and delineation drilling was being conducted in a third field, the Rong (Dragon), with expectations of initial production in 1995.[59]

Essential elements of the transportation infrastructure comprise about 85,000 km of roads, including 9,400 km bituminous, 48,700 km gravel or improved earth, and 26,900 km unimproved earth. The length of navigable inland waterways totals about 17,700 km, with more than 5,100 km navigable at all times by vessels up to 1.8-m draft. The rail system consists of about 3,050 km of track, including about 2,455 km of 1.000-m narrow gauge, 150 km of 1.435-m standard gauge, 230 km of dual gauge having three rails, and 225 km of unserviceable track. There are 50 principal airports with permanent-surface runways out of a total of 100 that are considered usable in the country. International shipping ports include Da Nang, Haiphong, and Ho Chi Minh City. The merchant marine fleet includes eight petroleum-oils-lubricants tankers and three bulk ore freighters. There is about 150 km of pipeline for refined oil products. Vietnam had an electric power generating capacity of 3,300 MW and produced power at the approximate level of 130 kW • h per capita in 1992.[60]

OTHER SOURCES OF INFORMATION

Agencies

General Department of Chemicals
Hanoi, Vietnam
Ministry of Construction
Hanoi, Vietnam
Ministry of Energy
Hanoi, Vietnam
Ministry of Heavy Industry
Hanoi, Vietnam
Ministry of Power and Coal
Hanoi, Vietnam
Ministry of Science, Technology, and Environment
Hanoi, Vietnam

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[1]Prepared by Chin S. Kuo.

[2]Where necessary, values have been converted from Afghan afghanis (Af) to U.S. dollars at the rate of Af650=US$1.00 for 1993.

[3]Prepared by Chin S. Kuo.

[4]Where necessary, values have been converted from Bangladesh taka to U.S. dollars at the rate of Taka39.75-US$1.00 for 1993.

[5]Prepared by John C. Wu.

[6]Where appropriate, values have been converted from Bhutanese ngultrum (Nu) to U.S. dollars at the rate of Nu25.45=US$1.00 in 1992.

[7]Prepared by John C. Wu.

[8]Where appropriate, values have been converted from Brunei dollars (B$) to U.S. dollars at the rate of B$1.60=US$1.00 in 1993. Brunei dollars are convertible at par with Singapore dollars.

[9]The Borneo Bulletin (Kuala Belait). New Natural Gas Export Accord Signed With Japan. Apr. 10, 1993, p. 1.

[10]South-East Asia Mining Letter (London). Brunei New LNG Storage Tanks in Use. V. 5, No. 23, Dec. 10, 1993, p. 4.

[11]———. Brunei Further Shell Gas Discovery. V. 5, No. 22, Nov. 26, 1993, p. 5.

Petroleum Economist (London). News in Brief: Brunei. V. 60, No. 4, Apr. 1993, p. 31.

[12]Prepared by John C. Wu.

[13]Where necessary, values have been converted from Burmese Kyats (K) to U.S. dollars at the rate of Ks6.1=US$1.00 in 1993.

[14]Ministry of National Planning and Economic Development. Review of the Financial, Economic and Social Conditions for 1993-94, p. 259.

[15]Htay, M. T. Mining Journal (London). Myanmar in Mining Annual Review 1994.

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[17]Sout-East Asia Mining Letter (London), Burma, Thai Tin Miner Signs PSC. V. 5, No. 20, Oct 29, 1993, p. 2.

[18]Second work in footnote 16.

[19]The New Light of Burma (Rangoon). Natural Gas Production Reportedly to Double. Jan. 12, 1994, p. 12.

[20]Prepared by Travis Q. Lyday.

[21]U.S. Central Intelligence Agency, Washington, DC: The World Factbook 1993, pp. 67-68.

[22]Prepared by Travis Q. Lyday.

[23]U.S. Central Intelligence Agency, Washington, DC: The World Factbook 1993, pp. 83.

[24]Prepared by Pui-Kwan Tse.

[25]Where necessary, values have been converted from the Hong Kong dollar (HK$) to U.S. dollars at the rate of HK$7.80=US$1.00 and Macau pataca to U.S. dollars at the rate of Pataca8.00=US$1.00 for 1993.

[26]Prepared by Chin S. Kuo.

[27]Where necessary, values have been converted from Korean Won (W) to U.S. dollars at the rate of W2.11=US$1.00 for 1993.

[28]Prepared by Travis Q. Lyday.

[29]U.S. Central Intelligence Agency, Washington, DC: The World Factbook 1993, p. 219.

[30]Prepared by John C. Wu.

[31]Where necessary, values have been converted from Mongolian tugriks (Tug) to U.S. dollars at the official rate of Tug/150.00=US$1.00 as of Apr. 1993. Unified free market exchange rate, as of May 31, 1993 was Tug/400=US$1.00.

[32]KYODO News Service (Tokyo). Statistics for 1993: Economy Contracts, Rise in Unemployment; and Trade Deficit. Jan. 12, 1994, p. 1.

[33]Nihon Keizai Shimbun (Tokyo). Trade Minister on Economic Reconstruction. Jan. 26, 1993, Morning Edition, p. 9.

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[41]———. Oil Prospecting Agreement Signed With Australia. Aug. 17, 1993.

[42]U.S. Embassy, Ulaanbaatar, Mongolia. State Dep. Telegram 002718, Sept. 10, 1993, p. 1.

———. Telegram 000244, Jan. 31, 1994, p. 1.

[43]Prepared by John C. Wu.

[44]Where appropriate, values have been converted from Nepalese rupees (NRs) to U.S. dollars at the rate of NRs49.2=US$1.00 in 1993.

[45]Nepal Press Digest (Kathmandu). The Udayapur Cement Factory. V. 37, No. 25, June 21, 1993, p. 222.

[46]The Rising Nepal (Kathmandu). Himal Cement Company Recovers Losses. V. 29, No. 74, 1994, p. 3.

[47]United Nations (New York). Chronicle of the United

Nations Mineral Resources Exploration in Developing Countries, 1958-93, Dec. 10, 1993, p. 38.

[48]Prepared by Pui-Kwan Tse.

[49]Where necessary, values have been converted from Singapore dollars ($) to U.S. dollars at the rate of S$1.60=US$1.00 in 1993.

[50]Prepared by Chin S. Kuo.

[51]Where necessary, values have been converted from Sri Lankan rupees (SLR) to U.S. dollars at the rate of SLR47.67=US$1.00 for 1993.

[52]Prepared by Travis Q. Lyday.

[53]Far Eastern Economic Review (Hong Kong). V. 157, No. 5, Feb. 3, 1994, pp. 21, 24.

[54]Where necessary, the Vietnamese dong (D) has been converted into U.S. dollars at the rate of D10,500=US$1.00, the approximate rate at yearend 1993.

[55]Mining Magazine (London). V. 169, No. 12, Dec. 1993, p. 40.

[56]Mining Journal (London). V. 321, No. 8246, Oct. 15, 1993, p. 260.

[57]South-East Asia Mining Letter (Hong Kong). V. 5, No. 24, Dec. 22, 1993, p. 8.

[58]Australia Mining Monthly (Leederville, Australia). June 1993, p. 106.

[59]Oil and Gas Journal (Tulsa, Oklahoma). V. 91, No. 43, Oct. 25, 1993, p. 23.

[60]U.S. Central Intelligence Agency, Washington, DC: The World Factbook 1993, pp. 413-414.

TABLE 11

VIETNAM: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Bauxite: Gross weight		6,000	6,500	6,000	6,000	6,000	6,500
Cement, hydraulic	thousand tons	2,000	2,500	3,000	3,000	3,000	3,000
Chromium: Chromite		r4,000	(3)	(3)	(3)	—	4,000
Clays: Kaolin		750	750	800	800	800	1,000
Coal: Anthracite	thousand tons	5,500	4,022	r e5,000	e5,470	6,000	e9,000
Gold	kilograms	1,200	1,200	1,300	10,000	10,000	10,000
Gypsum		25,000	25,000	30,000	30,000	30,000	30,000
Iron and steel: Metal:							
Steel, ingot	thousand tons	r84	r102	r e142	r e175	190	190
Steel, rolled	do.	50	50	50	50	50	50
Nitrogen: N content of ammonia		36,000	36,000	r30,000	r45,200	e51,700	e54,000
Petroleum: Crude	thousand 42-gallon barrels	e10,850	e19,700	e13,670	e38,950	45,000	e45,000
Phosphate rock:							
Gross weight	thousand tons	500	e274	274	275	250	500
P_2O_5 content	do.	175	96	96	95	95	XX
Salt	do.	320	340	350	350	350	450
Tin:							
Mine output, Sn content		850	850	800	r3,400	3,500	850
Metal, smelter		800	r1,800	r1,700	r2,400	2,500	e2,500
Zinc:							
Mine output, Zn content		r10,000	r10,000	15,000	15,000	15,000	e15,000
Metal, smelter, primary		r10,000	r10,000	10,000	10,000	10,000	e10,000

[e]Estimated. [r]Revised. XX Not applicable.

[1]Table includes data available through July 11, 1994.

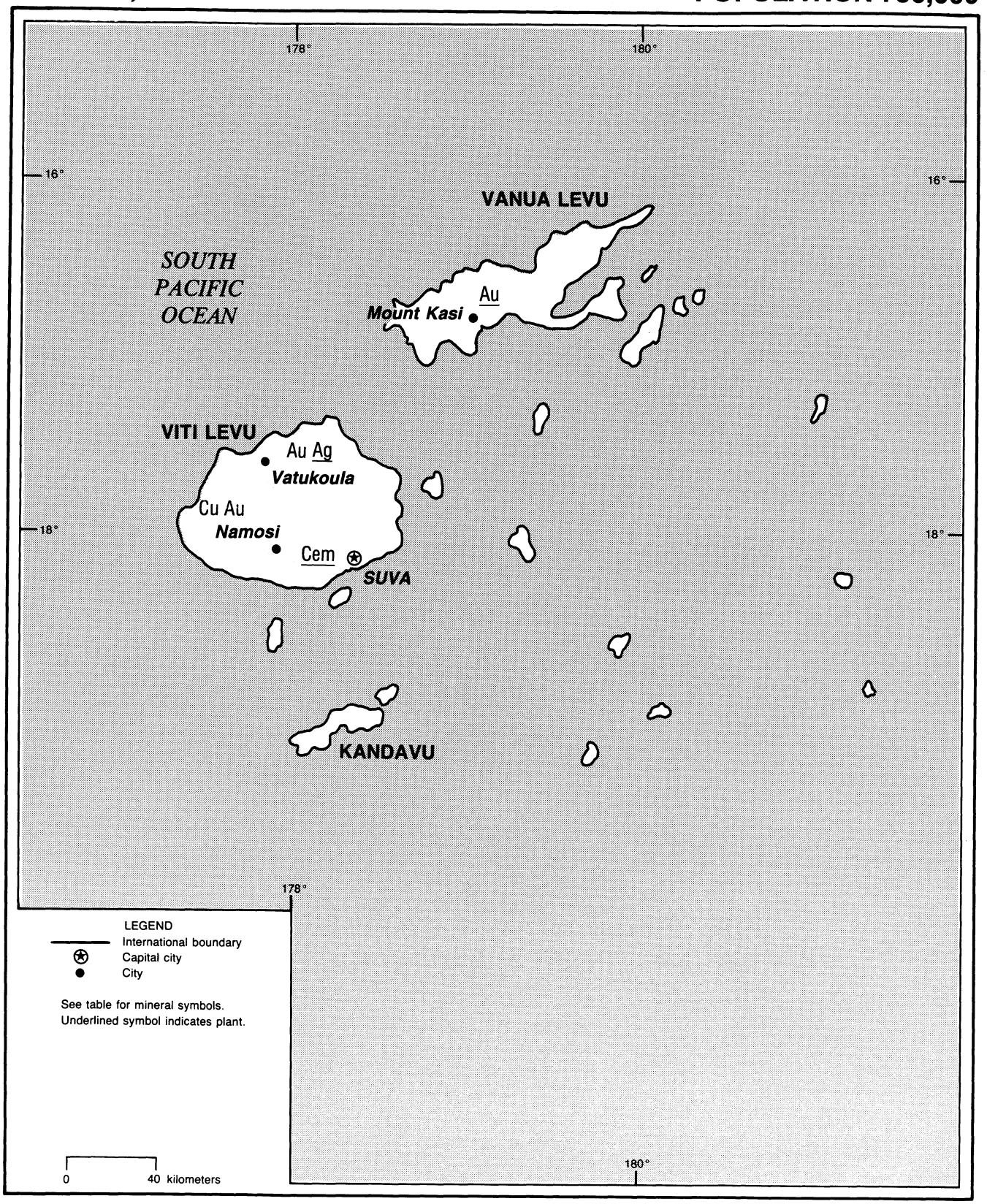
[2]In addition to the commodities listed, iron ore was mined in the past and pig iron was produced at industrial facilities, but the status of these industries under prevailing conditions is not sufficiently clear to allow formulation of reliable estimates of output levels. Similarly, data on output of crude construction materials are not available, and no basis is available to make reliable estimates of output levels.

[3]Revised to zero.

[4]Reported figure.

FIJI

AREA 18,270 km² **POPULATION 750,000**



THE MINERAL INDUSTRY OF

OTHER SOUTH PACIFIC ISLAND

By Travis Q. Lyday[1]

FIJI

The economy of Fiji remained agrarian, depending mainly on the sugar industry but also having a large subsistence sector. The mineral industry remained small, contributing an estimated 3% to the gross domestic product (GDP) of the country.

Gold continued to be the mainstay of the minerals industry in Fiji, accounting for virtually all of the contribution to the country's GDP from the mining and quarrying sector. The main operations were the Emperor Mine at Vatukoula, about 100 km northwest of the capital at Suva on the tip of the main island of Viti Levu, and the Tavua Basin Mine, inland from Tavua and about 2.5 km south of the Emperor Mine. The Emperor Mine has been in continuous production since 1935 while production from the Tavua Basin Mine began in 1987. Both mines produced byproduct silver and were owned and operated by Emperor Gold Mining Co. Ltd. (EGM). The Emperor Mine also recovered until 1980 significant amounts of selenium and tellurium oxides from the ore.

The Emperor Mine in the past few years has evolved from being solely an open cut, to a surface-underground composite, to exclusively in 1993 an underground operation.

EGM terminated in midyear its 80%-owned subsidiary, Pacific Sovereign Mint Ltd. Pacific Sovereign, in conjunction with the Government-owned Fiji Development Bank, minted legal-tender gold coins and made gold jewelry from unrefined gold mined at the Emperor and Tavua Basin Mines. The mint had been operating at a loss since it was established in 1991.

Placer Dome Inc. of Vancouver, Canada, withdrew at the end of October from the 50-50 Namosi exploration project with Australia's Sydney-based Placer Pacific Ltd. Placer Pacific, a 75.7% subsidiary company of Placer Dome, had been the manager of the joint venture, formed in 1992 to explore the Namosi low-grade porphyry copper prospect, while Placer Dome had been fully funding the program. Placer Pacific intended to have the Namosi tenements transferred solely to its local subsidiary, Placer Pacific Namosi Ltd., and to continue the investigations itself.[2] The Namosi prospect, about 30 km northwest of Suva, was considered as having the potential to become a world-class-size copper-gold mine.[3]

Pacific Islands Gold NL submitted to the Department of Mineral Resources in December an application for a mining lease for its Mount Kasi gold project on the coast of Vanua Levu, Fiji's second largest island. Pacific Islands Gold envisioned developing an open pit operation toward yearend 1994, initially mining 300,000 mt/a of low-cost eluvial ore, tapering to 250,000 mt/a of higher grade epithermal ore as the pit deepened. Production was planned to be about 600 kg/a of gold. A mine at Mount Kasi previously operated from 1932 to 1942.[4]

Metallic mineralization is widespread in Fiji, occurring as polymetallic base metal sulfide deposits, disseminated porphyry copper deposits, epithermal precious-metal deposits, residual bauxite deposits, and manganese and heavy-mineral sand deposits. However, gold along with associated silver is the only mineralization being mined at present. Fiji's mineral industry also consisted of a cement plant and several quarries for the production of stone and crushed gravel, limestone, and coral and river sands.

Essential elements of the islands' infrastructure include 644 km of 0.610-m narrow-gauge railroad belonging to the Government-owned Fiji Sugar Corp.; 3,300 km of roads, including 1,590 km paved; 1,290 km gravel, crushed stone, or stabilized-soil surface; and 420 km unimproved earth. Inland waterways consist of 203 km, of which 122 km is navigable by motorized craft and 200-ton barges. There are 4 ports for international shipping and 25 airports in the country, 2 with permanent-surface runways. Fiji had an electric-power generating capacity of 215 MW and produced power at the approximate level of 560 kW • h per capita.[5]

Generally, infrastructure for mineral industry operations are regarded as adequate.

OTHER SOURCES OF INFORMATION

Department of Mineral Resources
Private Mail Bag
Suva, Fiji
Telephone: +679 383 611
Fax: +679 370 039

TABLE 1

FIJI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993	Annual capacity (Jan. 1, 1994)
Cement, hydraulic		58,000	r77,900	r78,800	r84,400	81,400	97,900
Gold, mine output, Au content	kilograms	4,221	r4,116	r2,713	r3,847	3,784	4,200
Lime[e 2]		2,000	—	—	—	—	2,350
Silver, mine output, Ag content	kilograms	1,055	r779	r477	r1,258	1,112	1,300
Stone, sand and gravel:							
Coral sand for cement manufacture		48,809	64,997	71,664	61,465	65,303	161,000
River sand for cement manufacture		15,009	8,393	19,386	e20,000	13,186	40,000
River sand for gravel, n.e.s.	cubic meters	230,780	838,756	e800,000	e800,000	e800,000	1,220,000
Quarried stone	do.	65,849	152,455	73,771	63,412	84,670	225,000

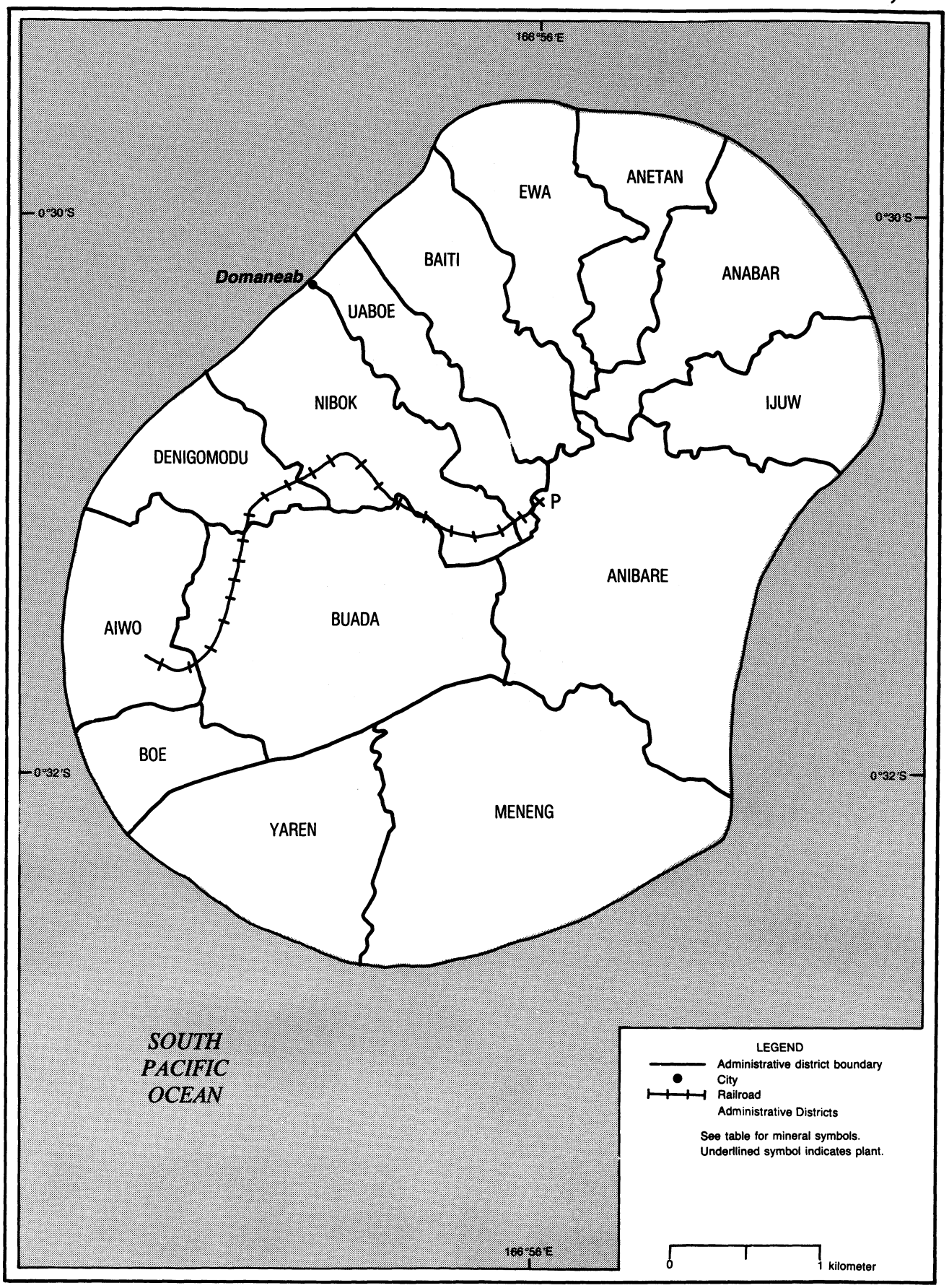
eEstimated. rRevised.

[1]Table includes data available through Aug. 10, 1994.

[2]Produced from an unreported amount of domestically quarried limestone.

NAURU

AREA 21 km² **POPULATION 9,500**



NAURU

The 21-km^2 island of Nauru was one of three historic phosphate-producing islands of the Pacific. The other two were Banaba (or Ocean Island) in the Gilbert Islands Group of Kiribati and Makatea, part of French Polynesia; however, Nauru was the only remaining producer.

Nauru was the world's smallest nation. It also had one of the highest per capita incomes in the world. The economy continued to be based on the mining of extensive high-grade phosphate rock deposits on the central plateau of the island by the Government-owned Nauru Phosphate Corp. (NPC). The deposits were among the richest in the world, having a consistent content of 84% bone phosphate of lime (BPL) or tricalcium phosphate, equivalent to 38.5% phosphorus pentoxide (P_2O_5). Rock treated in the calcination plant averaged about 89% BPL (40.7% P_2O_5) and could be as high as 91% BPL (41.7% P_2O_5).

Phosphate rock was mined from deposits interdigitated with evenly spaced dolomitized coral limestone pillars using mechanical extractors with clamshell buckets, leaving the coral as a "forest" of very hard-rock pinnacles. The associated coral was cobbed for domestic use as road aggregate.

After overburden was removed by bulldozing, the alluvial phosphate rock was removed from around the coral pinnacles, trucked to a railhead for primary crushing, and reduced to minus 50 mm. A narrow-gauge railway using diesel locomotives transported the crushed material to a treatment plant where it was dried before further crushing to minus 12 mm and sold as run-of-mine product. A proportion of the fine material was upgraded by high-temperature calcination to remove organic carbon and marketed as Nauru Calcined Rock.

Essential elements of the communications-transportation infrastructure included about 27 km of roads, including 21 km with pavement and 6 km of unimproved earth or dirt track. There was 3.9 km of NPC-owned railroad track, which was used to transport phosphate from the central plateau of the island to the processing facilities in Aiwo District on the southwestern coast. There was only one airport, and it had permanent-surface runways 1,220 to 2,439 m in length. The only port was that in Aiwo District. Nauru had an electric-power generating capacity of 14 MW and produced power at the approximate level of 5,430 kW • h per capita.[6]

An agreement with Australia was reached in August, thus ending Nauru's petition filed in May 1989 in the International Court of Justice at The Hague, Netherlands, for compensation from the former partners of the British Phosphate Corp. (BPC). The BPC, composed of Australia, New Zealand, and the United Kingdom, controlled the phosphate industry on the island from 1919 until 1968. The suit was filed against Australia as the administering authority on behalf of the other partners for failure to rehabilitate the environmental damage to the land caused by phosphate mining during the period governed by the BPC. Under the terms of the settlement, Australia will pay a total of $73 million[7] to Nauru, with $34 million paid prior to August 1994 and the remainder parcelled out over the following 20-year period.[8]

OTHER SOURCES OF INFORMATION

Nauru Phosphate Corp.
Republic of Nauru
Central Pacific Ocean
Telephone: +674 4180 or +674 4198

TABLE 2
NAURU: PRODUCTION OF PHOSPHATE ROCK[1]

(Thousand metric tons)

Commodity[2]	1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Phosphate rock	1,181	926	530	747	642	1,550

[e]Estimated.

[1]Includes data available through July 11, 1994.

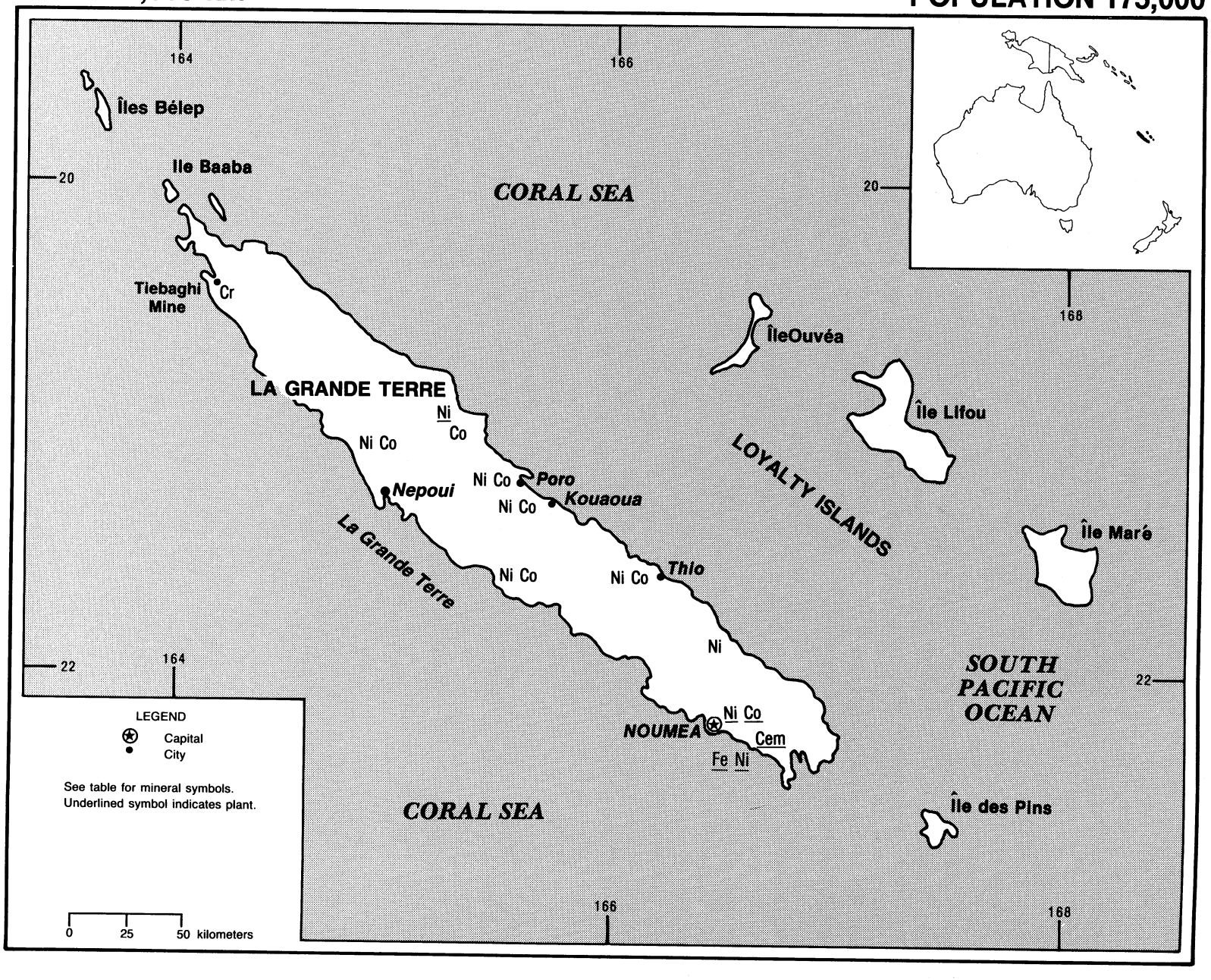
[2]In addition to the commodity listed, crude construction materials (common clays, sand and gravel, and stone) are produced, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.

NEW CALEDONIA

(France)

AREA 19,060 km²

POPULATION 175,000



NEW CALEDONIA

The mineral industry in the French Territory of New Caledonia and Dependencies continued to be dominated by the mining of nickeliferous laterite-saprolite ore, which was used for the subsequent production of ferronickel of various grades and of nickel matte at the Doniambo smelter at Nouméa, the capital. Minor amounts of cobalt were recovered as a component of nickel matte exports from refining operations at Sandouville, near Le Havre, northern France. Minor amounts of pit and quarry construction materials also were produced.

New Caledonia remained the third largest producer of mined nickel in the world after Canada and the former U.S.S.R. and was the largest producer of ferronickel, with about 40% of the world's output. Nickel mining and smelting is the territory's largest foreign exchange earner.

Nickel was produced at mines owned by Société Métallurgique le Nickel-SLN (SLN), a 95%-owned subsidiary of Metropolitan France's Eramet-SLN, and from smaller, independent producers. SLN produced about 65% of the territory's nickel ore at its two mining centers of Kouaoua and Thioon the east coast and at contractor-operated mines operated by Société Georges Montagnat at Karembe and Tontouta on the west coast of La Grande Terre, the main island. The remaining 35% came from smaller, independent operators, including Berton, Groupe Pentacost, Société des Mines de la Toutouta, and Société Minière du Sud Pacifique, with open pit mines at Boakaine, Karembe, Kouaoua, Moeno, Nakety, Ouaco, and Tontouta.

Mine output from the independently operated mines was mainly for export to Australia's Yabulu nickel refinery near Townsville, Queensland; Japanese nickel smelters and refiners; and the Glenbrook ferronickel smelter near Riddle, Oregon; some also was used as feed for the Doniambo smelter. SLN's nickel ore primarily was used as feed for its Doniambo smelter at Nouméa for the production of ferronickel ingots and shot and nickel matte, with minor amounts exported to Japan. Most of the ferronickel production was shipped to consumers in Australia, and all production of nickel matte was shipped to Eramet-SLN's refinery at Sandouville-Le Havre for further processing into high-purity electrolytic nickel and nickel salts.

Maintenance work on one of the three Demag electric furnaces was completed as scheduled during the first quarter; although the plant was restored to its nominal capacity, it continued to be operated at a reduced level for the remainder of the year owing to the poor world nickel market.[9]

SLN's Nepoui Mine project, the only new mine development underway in New Caledonia, progressed on course for startup in 1994.[10]

In addition to abundant reserves of nickel ores, the island territory is well endowed with other mineral resources. Significant prospects have been reported for antimony, copper, gold, iron ore, lead-zinc, manganese, and phosphate rock. However, none of these has been mined commercially.

The transportation infrastructure includes 6,340 km of roads, of which only about 10% is paved, with the remaining improved earth. There are 29 airports serving the country, 2 with permanent-surface runways. International shipping ports include the port at the capital city of Nouméa and the ports at Népoui, Poro, and Thio. Electricity generating capacity was 400 MW.[11]

OTHER SOURCES OF INFORMATION

Agency

Le Service des Mines et L'Energie
Nouméa, New Caledonia

Publications

Service de la Statistique (Paris). Annuaire Statistique, annual.

Annales des Mines (Paris). Productions et Exportations Minères & Métallurgiques de la Nouvelle Calédonie, monthly.

TABLE 3

NEW CALEDONIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity (Jan. 1, 1994)
Cement		67,232	65,000r	89,739	90,417	90,000	90,500
Chromite, gross weight		60,281	6,223	—	7	—	—
Cobalt, mine output:e							
Co content		6,000	6,000	6,000	6,000	6,000	6,000
Recovered		800	800	800	800	800	800
Nickel:							
Ore:							
Gross weight	thousand tons	4,919	4,486	5,690	r5,650	25,599	5,700
Ni content		96,200	85,100	114,492	r113,000	98,100	XX
Metallurgical products:							
Ferronickel:							
Gross weighte		142,500	126,500	137,600	r125,900	145,500	165,850
Metal content (nickel plus cobalt)		36,285	32,278	34,411	31,895	36,850e	42,0002
Nickel matte:							
Gross weighte		14,500	13,000	r12,200	r10,100	19,800	20,000
Metal content (nickel plus cobalt)		10,650	9,683	9,041	7,475	210,883	211,000
Stone:e							
Crude (unspecified)	cubic meters	20,000	25,000	25,000	25,000	25,000	25,000
Crushed	do.	100,000	125,000	125,000	125,000	125,000	125,000
Sand:e							
Construction	do.	75,000	100,000	100,000	100,000	100,000	100,000
Silica (for metallurgical use)	do.	15,000	20,000	20,000	20,000	20,000	20,000

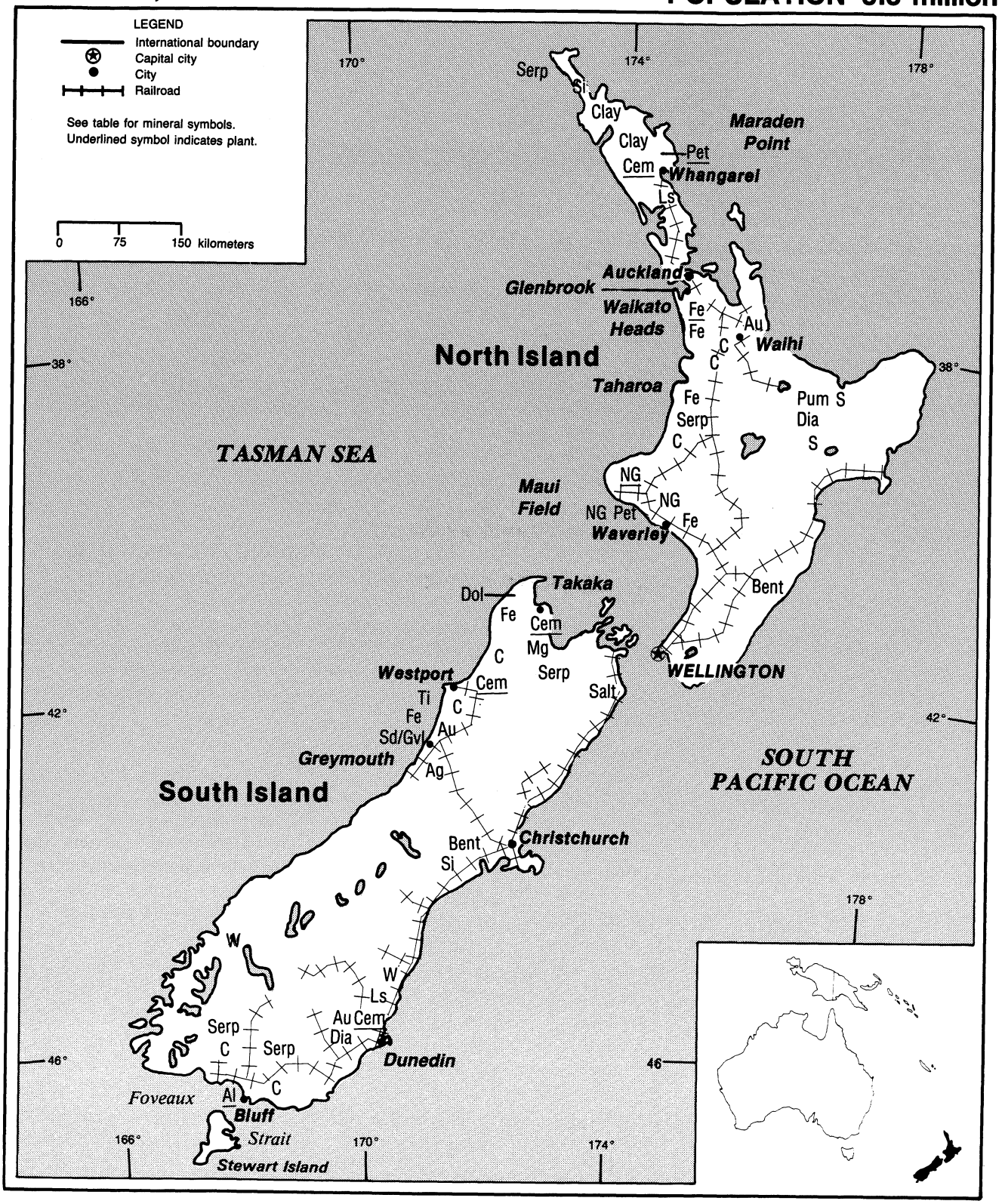
eEstimated. rRevised. XX Not applicable.

[1]Table includes data available through Aug. 10, 1994.

[2]Reported figure.

NEW ZEALAND

AREA 268,680 km² **POPULATION 3.3 million**



NEW ZEALAND

The New Zealand mining industry is centered primarily on coal and gold, mineral commodities with long traditions in the country. The mineral industry in New Zealand began with the discovery of gold on the Coromandel Peninsula, North Island, in 1852. Coal mining also began in the 1850's and, early in this century, its production value exceeded that of gold for the first time. During the 1960's, building aggregates replaced coal as the country's most valuable mineral product. In the early 1980's, aggregates were, in turn, replaced by natural gas as New Zealand's most valuable mineral product.

The existence of extensive iron sand deposits on the west coast of North Island has been known for more than a century, but not until the late 1960's was a steelmaking industry in New Zealand able to use successfully the iron sands and coal from an area near Waikato-North Head. Construction of the Glenbrook steelworks was completed in 1970.

Serious exploration for oil and gas began in the late 1950's, resulting in the discovery of several natural gas fields to date. The Kapuni Field was discovered in 1959 and began production in 1970, supplying gas to North Island Government distribution centers and industrial customers. The much larger Maui offshore gasfield, New Zealand's largest, was discovered in 1969. Its production has been used primarily for electricity generation and as a premium fuel.

New Zealand's extractive mineral industry constitutes only a small segment of the economy, contributing about 1% to 2% to the gross domestic product (GDP) of the country. The mineral processing sector provides an estimated 4% to 5% to the GDP, based to a significant extent on imported alumina, crude oil, and fertilizer, increasing the value of the mineral industry output to about 5% to 6% of GDP.

Mining activities in New Zealand during the year continued to include coal extraction, both by underground and open pit methods; quarrying of raw materials for use primarily in domestic construction (clays, sand and gravel, and stone) and agricultural industries (limestone and marble); and gold and titaniferous magnetite sand (iron sand) mining. There were three hard-rock gold mining operations, the Golden Cross and Martha Hill operations near Waihi at the base of the Coromandel Peninsula on North in the Eastern Otago region of South Island. Alluvial mining occurred at several sites, especially on South Island. Mineral production also included natural gas, natural gas liquids, and petroleum condensate.

New Zealand's downstream mineral industry consisted of two steel mills, an aluminum smelter, aluminum, copper, and brass extrusion plants, and an oil refinery, all of which primarily used imported raw materials.

A new long-term electricity supply contract was approved in December by the Government, concluding 7 years of negotiations with New Zealand Aluminium Smelters Ltd. (NZAS), operator of the Tiwai Point aluminum smelter at Bluff, Southland, on the southern tip of South Island. The deal will guarantee for NZAS the security of electrical power supply until 2012 in exchange for a gradual increase in its cost to full market value. As a result of the power agreement, the two partners in NZAS, Comalco New Zealand Ltd. holding 79.36% and Sumitomo Chemical Co. Ltd. with 20.64%, announced the decision to proceed with a $160 million[12] upgrade of the smelter to increase production by more than 30,000 mt/a.[13] The Tiwai Point smelter originally was commissioned in 1971 and subsequently expanded to its current production capacity of about 259,000 mt/a from three potlines.[14]

Coeur Gold New Zealand Ltd., a subsidiary of Coeur d'Alene Mines Corp. of Idaho, bought in midyear Cyprus Gold New Zealand Ltd.'s 80% interest in the Golden Cross open pit/underground gold mine on North Island's Coromandel Peninsula. The Golden Cross Mine, 8 km northwest of Waihi, began production early in 1992 in a joint venture with Viking Minerals Co. Ltd., a subsidiary of New Zealand's privately held Todd Corp. Ltd.[15]

Mining commenced in July at the Island Block alluvial gold operation south of Miller Flat in the central Otago region of South Island. The mine is a joint venture owned 40% each by Perilya Mines N.L. of Australia and March Mining (Central) Ltd., with the remaining 20% held by private interests.[16]

Macraes Mining Co. Ltd. (MMC), New Zealand's premier gold producer, was planning to expand the treatment plant from the present 2.1 Mt/a of ore throughput to 3 Mt/a at a cost of $5.3 million at its Macraes hard-rock gold mine in the eastern Otago region of South Island.[17]

Titanomagnetite-bearing iron sand continued to be mined and concentrated at two unique projects along the western coast of North Island by New Zealand Steel Ltd. (NZ Steel), a wholly owned subsidiary of Australia's BHP Steel. Titanomagnetite concentrate was produced by dry-mining (bulldozing and bucket-wheel excavation) methods at Waikato-North Head, about 50 km south of Auckland, and pumped as a slurry through an 18-km pipeline to NZ Steel's integrated Glenbrook Steelworks. NZ Steel used both wet- (suction dredging) and dry-mining methods to produce an iron sand concentrate at its Taharoa project, about 100 km farther south. The Taharoa concentrate, averaging about 40% titanomagnetite by weight, was exported exclusively to Japan in specially fitted slurry ore carriers loaded at a mooring buoy connected to shore by a 3-km slurry pipeline. The product was used as a steelmaking additive and as a refractory in blast furnace operations.[18]

The communications and transportation infrastructure of New Zealand is well developed. There are 4,716 km of Government-owned railroads, of which 113 km is electrified; 92,648 km of roads, including 49,547 km paved and 43,101 km gravel or crushed stone. There are 33 principal airports with permanent-surface runways out of an aggregate of 120 serving the country. Inland waterways, of which there is 1,609 km, are of little importance to the

transportation industry. International shipping ports include Auckland, Christchurch, Dunedin, Tauranga, and Wellington. The merchant marine fleet includes four petroleum-oils-lubricants and one liquefied gas tankers and five bulk ore freighters. There is 1,000 km of pipeline for natural gas, 160 km for refined oil products, and 150 km for condensate. New Zealand had an electric power generating capacity of 8,000 MW and produced power at the approximate level of 9,250 kW•h per capita in 1992.[19]

OTHER SOURCES OF INFORMATION

Ministry of Commerce
P.O. Box 1473
Wellington, New Zealand
Telephone: +64 4 720 030
Fax: +64 4 739 930

Mining & Exploration Association Inc.
P.O. Box 27314
Wellington, New Zealand
Telephone: +64 4 851 141
Fax: +64 4 851 155

TABLE 4
NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacitye (Jan. 1, 1994)
METALS							
Aluminum metal, smelter:							
Primary		r257,462	r259,710	258,500	r242,900	2268,000	2259,000
Secondary		4,500	4,800	4,700	r6,700	7,000	7,000
Total		r261,962	r264,510	263,200	r249,600	275,000	266,000
Gold, mine output, Au content	kilograms	4,766	4,626	6,758	r10,531	11,000	11,000
Iron and steel:							
Iron ore, gross weighte 3		—	—	2,060	2,000	2,000	2,650
Iron sand (titaniferous magnetite):							
Gross weight	thousand tons	2,367	2,296	2,265	r2,934	2,300	2,950
Fe contente	do.	1,300	1,300	1,300	1,300	1,300	XX
Direct-reduced iron	do.	493	549	594	384	2406	600
Steel, crude	do.	608	r719	r806	759	2850	850
Lead, refinery output, secondarye		25,000	5,000	5,000	5,000	5,000	6,000
Silver, mine output, Ag content	kilograms	4,837	4,914	11,370	r22,413	19,500	22,500
INDUSTRIAL MINERALS							
Cement, hydraulic	thousand tons	729	e750	576	579	600	900
Clays:							
Bentonite		1,342	1,393	—	—	—	1,500
Kaolin (pottery)		26,324	25,435	21,338	r27,520	25,000	27,550
For brick and tile		60,438	65,644	121,030	r55,871	65,000	147,000
Lime		100,000	100,000	90,000	100,000	100,000	160,000
Nitrogen: N content of ammonia		e70,000	e70,000	70,000	68,200	277,800	73,000
Perlite		2,500	1,972	1,674	2,000	2,000	2,500
Pumice		40,974	100,584	52,644	r112,476	50,000	112,500
Salte		76,000	80,000	80,000	80,000	80,000	80,000
Sand and gravel:							
Silica sand (glass sand)		102,131	100,280	99,132	r71,940	100,000	135,000
Other industrial sand		316,930	444,986	494,428	r427,714	500,000	500,000
For roads and ballast	thousand tons	12,577	12,090	10,460	r12,520	10,000	16,500
For building aggregate	do.	5,172	4,121	3,486	r3,838	5,000	5,175

See footnotes at end of table.